INDUSTRIAL ENGINEERING

with which is consolidated

INDUSTRY ILLUSTRATED

Electrical, Mechanical and Plant Service in Industry

Published by McGraw-Shaw Company

Volume 86 NEW YORK, APRIL, 1928 *Number 4*

The Goose and the Golden Eggs

An editorial that will interest the friends of improved machinery

. . . Remember the fable about the Goose and the Golden Egg? It was written some two thousand years ago, but expresses a frailty in human nature that is as prevalent today as it was in Aesop's time.

. . . A farmer, (so the fable runs) possessed a wonderful goose. Each day it laid a golden egg. Backed by this apparently unlimited gold reserve, the farmer's family began to step out. Expenditures mounted so fast that the willing but limited goose could not make supply meet demand. So the foolish farmer took the goose apart with the aid of his knife, thinking thus to secure at once its entire capital instead of accepting daily instalments. The operation was *not* a success!

. . . American Industry has been blessed with a Golden Goose. This fowl has not merely laid a golden egg each day but it has been making them larger and larger. This Golden Goose has increased the total output of American made products 65 per cent in the period from 1914 to 1925*. It has required the addition in the interim of one and one-half million workers to our total labor force in manufacturing industries. It has made the purchasing power of wages in this country far greater than in any other land. It has increased the people's savings in savings banks, insurance and building and loan society assets—the wage earner's savings—from less than fifteen billion dollars in 1914 to over forty-three billion dollars in 1926.

. . . The goose that has laid these marvelous golden eggs for us is the intelligent use of Labor Saving Machinery.

. . . Yet because there has been a temporary slackening of employment, a slowing down for industry to catch its breath for another spurt—there are those who would swing the axe at America's Golden Goose. And so one sees newspaper headlines charging the responsibility for unemployment to labor saving machinery.

. . . The farmer blamed his goose for not keeping pace with the extravagant demands of himself and his family. What ignorance of economics! But not greater ignorance than to charge labor saving machinery with being destructive to employment. Machinery and power have been the most powerful factors in emancipating labor from physical and economic slavery and have made a hundred well paid jobs grow where there was originally but one lean one.

. . . You men who read this editorial know the prosperity power of improved machinery. It is up to you to help controvert this wrong and harmful propaganda. Further facts and statistics on the subject will be found on page 203 of this issue.

. . . Let's put the blame for unemployment where it belongs, on extravagance, speculation and political uncertainty—but spare the goose that lays our golden eggs!

*Last available census period.

Fumes are removed by the exhaust hoods above the melting pots

C. A. BOOTH *describes some of the*

Vice-President
Buffalo Forge Company
Buffalo, N. Y.

Requirements of VENTILATION *for Process Work*

IN MANY installations the dipping tanks, cooking vats, dye tubs, storage batteries, or what not fill practically all the available floor space and, either on that account or because hoods and enclosures would interfere with working conditions, it is possible to provide sufficient ventilation only by flushing the entire room with fresh air. Therefore, the question of special ventilation needed in connection with industrial and chemical operations in the course of which obnoxious or poisonous fumes and the like are created, is frequently handled as a problem in room ventilation.

Each industry, and for that matter each operation that has general application, is peculiar to itself, and by experience methods have been developed which, although they conform in general engineering features, have peculiar details necessitated by the requirements of the industry. One of the commonest examples of this is the ventilation of incandescent lamp works where a large number of operators are employed on semi-automatic machines using gas flames for such operations as blowing the bulbs, inserting the bases, and sealing the tips. The number of operators and the heat from the gas flames combine to produce conditions that are unbearable unless mechanical ventilation is used. Providing this would be a simple matter if it were not for the necessity of avoiding drafts which would deflect the gas flames.

Several unsuccessful attempts were made before a central ventilating system was devised which employs large ducts and low-velocity outlets placed at frequent intervals so that ample ventilation is supplied without draft. The central air supply also enabled a spray-type air washer to be used for summer cooling and for the removal of dust, so that instead of being unbearable, the working conditions in these plants are now most desirable. Practically every incandescent lamp factory in the country is so equipped.

The nuisance and waste caused by excessive fogging in dye houses and in the machine rooms of paper mills is a thing of the past, as the result of intelligent engineering work. In dye houses a great deal of vapor is set free by the boiling dye tubs. In the paper machine rooms many times the weight of the finished paper is evaporated during the passage of the pulp over the dryers. In the hot months very little trouble results and open windows provide sufficient ventilation, but during six or seven months of the year open windows simply aggravate the situation. Un-

til a few years ago it was considered natural and inevitable that the fog should be so thick as to limit the vision to 6 or 7 ft. The writer recalls paper mills and dye houses in which objects were not visible a yard away.

It was quite common practice to install large propeller fans in the outside walls and windows, the object being to draw out the steam. Although these fans appeared to be discharging great volumes of steam they did not help matters, because the removal of so much hot air caused an inward leakage of cold air, causing more condensation and worse fogging than before. The proper solution, of course, was to introduce dry air, warmed to above the room temperature, so that this warm air with its great moisture-absorbing capacity would blot up the fog, and air leakage would be outward rather than inward.

It is still advisable in many cases to use hoods directly over the paper machines and over the dye tubs, but these are only an auxiliary and are used in connection with the supply of air from outdoors that is heated before being brought in. These hoods and stacks then become the natural channel for carrying off the moisture which is continually being blotted up by the warm air supply.

Systems such as those just mentioned have quickly become standardized and represent common practice, although they were at one time or another the subject of individual treatment with varying results. There are many other industries which have common problems whose solution is likewise becoming well standardized.

In the removal of dust or fumes, exhaust systems are usually employed, rather than a flushing or dilution of the air by a supply system, although sometimes both are required; the exhaust system may take out such a large volume of air that it is necessary to provide a supply system with adequate heating capacity to balance the exhaust. It is good engineering in the design of any exhaust system to remove the dust or fumes at the source; the closer the confining hood can be placed, the more efficient the removal will be.

If it is a hot process, the air will tend to rise and the hood must be placed above, rather than at the side. In any case, it must be borne in mind that the suction effect of an exhaust system will be felt only a very short distance away from the mouth of the hood. When air issues from a duct at a considerable velocity, it continues in a straight line and the draft may be felt a long distance away, but when air enters a pipe at the same rate, it comes from all directions and there is no noticeable velocity more than a few inches away. Hence, the necessity of using exhaust hoods that are close to the tanks, vats, or machines from which the vapor is being driven off. Wherever air enters around the hood its travel should be in a direction calculated to assist the removal of the vapors, and not interfere with their flow.

Steam vapor has a natural tendency to rise at a velocity of about 250 ft. per min., and the capacity of an exhaust system for removing it should be dependent upon the rate at which the vapor is being driven off, and also, to some extent, on the cubic contents of the room. Thus, in a process room of reasonably small dimensions the face velocity of air movement over the projected area of the hood does not have to be very high in order to give the room a rapid air change, and as the make-up air is moving only a short distance to the hood, the vapors are directed to the exhaust inlet and have little chance to escape into the room.

Hoods over vats, kettles, or furnaces should extend at least 6 in. beyond the edge of the vat in each direction. If the hood is necessarily

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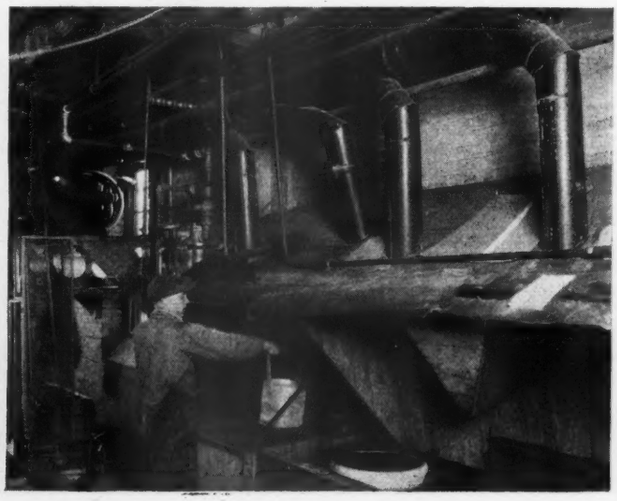
Speaking of Belting—

In our May issue, Roy C. Moore, Chief Engineer of Chas. A. Schieren Company, will discuss special drive conditions and tell just what allowances must be made in applying manufacturers' horsepower ratings in each case.

—and Electrical Distribution

A wiring system that can be permanently installed, and yet provides for all kinds of changes and rearrangements—a few years ago, this would have seemed too good to be true. It isn't a dream, however, and, next month, L. R. Bogardus, Chief Electrical Engineer of the Packard Motor Car Company, will tell you about it.

PROPELLER FANS are used here to remove the fumes from soldering. The desk fans are used for cooling only.



EXHAUST HOODS carry away the dangerous fumes from this acid bath used for cleaning metal parts.

placed more than 2 ft. above the top of the vat, the size should also be increased by an additional 6 in. in each horizontal dimension for an additional 2 ft. of elevation. The area of the pipe opening is usually about one-sixteenth of the hood mouth. For instance, a furnace 2 x 4 ft. with a hood 4 ft. above it would have a hood 4 x 6 ft. in horizontal dimensions and an exhaust pipe 1½ sq.ft. in area.

In some manufacturing processes it is necessary to have even more positive removal of poisonous gases than can be obtained by an open hood. One way of accomplishing this is to use an inner or false hood which, in addition to the large opening at the top, also has a slot all around the edge through which air is drawn at a comparatively high velocity. The velocity through this slot is usually about 1,000 ft. per min., and the use of the inner hood reduces the chance of fumes escaping into the room.

Air velocities used for exhaust systems may be as low as 100 ft. to 250 ft. per min. at the mouth of the hood, if the fumes removed are not particularly objectionable. Where thorough removal is essential the velocities at the mouth of the hood may be somewhat higher. The pipes or ducts may have a velocity of 1,000 to 2,000 ft. per min. when solid material is to be conveyed. If higher velocities are used, smaller ducts will convey the same amount of air, but with an increased friction loss which must be provided for by running the exhaust fan at higher pressures, and consequently using more power. There is, as in all engineering practice, a mean between first cost and operating cost. If a process is in continuous operation it will pay to invest more money for larger ducts, so as to reduce the power requirement, whereas for occasional use the smaller, cheaper installation which takes more power may still be the best investment.

When solid material has to be removed, the duct velocity must be sufficient to keep the material in suspension; it is also important in such cases that a uniform velocity can be maintained throughout all sections of the exhaust system. The velocities that have been found safe in actual practice are shown in the following table:

Material	Velocity Ft. per Min.
Light shavings*	2,400
Dry sawdust*	3,000
Knots, blocks*	3,600-4,000
Wheat	5,500-6,000
Corn	5,500-6,000
Oats	4,500-5,000
Wool	4,500-5,500
Cotton	4,000-5,000
Tags	4,000-5,000
Dried vegetable pulp	4,500-5,000
Salt	5,500-6,500
Sand	6,500-7,500
Powdered coal	4,000

*Exhaust systems only; higher velocities should be used for conveying.

There are many situations that require special treatment, as, for example, chemical processes generating corrosive gases and necessitating that the entire exhaust system be of such material that it will not quickly deteriorate. It is usually easy to find suitable material for the hoods, ducts, and other stationary parts, but exhaust fans, on account of the greater scouring effect are subject to a much more rapid action.

Exhaust fans are made of a great variety of materials, in addition to the usual cast iron or steel plate. For instance, earthenware, wood, copper, aluminum, and lead are some of the more common materials used, whereas various alloys, such as monel metal and Everdur, have the ability to resist the attacks of certain acids or combination of acids. Rubber-covered fans have excellent acid-resisting qualities, but until recently no satisfactory process of applying a rubber coating to a more or less complicated surface like a fan rotor had been devised. Such a process is now available, in which a thick sheet of rubber is vulcanized directly on the metal, and rubber-covered fans are giving good service on exhaust systems in chemical plants. Wherever the acid is so diluted that the corrosive action is slow, it may be good economy to use a cast-iron housing and a wheel of the usual steel plate construction. The cast-iron housing will last indefinitely, and the wheel can be replaced at small expense.

If it is not possible to handle the gases through a fan, a Venturi stack provides a means of ejecting the gases by the introduction of a small volume of air at high velocity, which in connection with a carefully designed Venturi nozzle induces a flow of gas by suction.

* * * *

FOG HAS BEEN ELIMINATED in this dye house by the introduction of dry air warmed to above the room temperature, which blots out the steam. The hoods above the vats are used to carry off the moisture.

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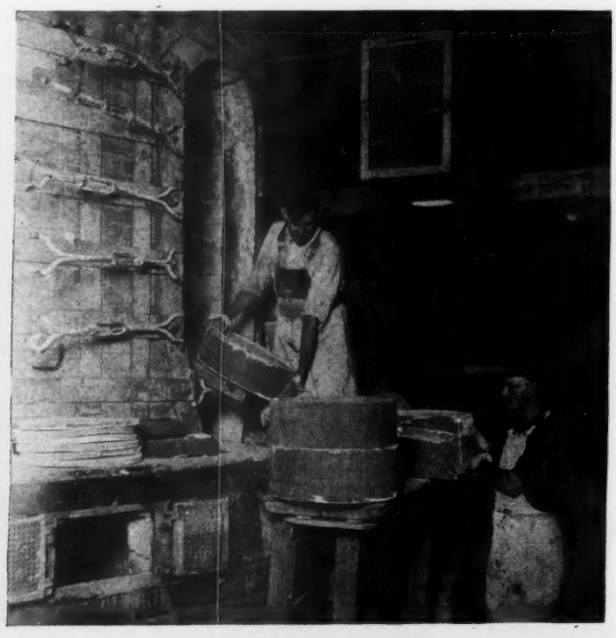
RAPID DISSIPATION OF HEAT is the end sought in this case. The fan in the wire cage blows cool air into the china kiln permitting men to work in the kiln about ten hours sooner than would otherwise be possible.



Underground Distribution Systems

for the localization of Plant Services

Provision for expansion and contraction of pipe lines should be made by installing expansion joints

By K. D. HAMILTON

Plant Engineer
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Campello, Mass.

THE PROBLEMS met in the distribution of high-pressure and low-pressure steam, electrical energy, water, compressed air, and other services from a central power station to a manufacturing plant are many, particularly when the plant buildings are scattered and some distance away from the main power house. The planning of such distribution systems should be undertaken with the object of reducing losses to the minimum consistent with economy, and providing systems that will be free from complicated arrangements of valves and wiring feeders, and not subject to breakdowns.

In the design of such a system we must decide, for example, whether the steam shall be distributed at high pressure through the various buildings and then reduced to the heating pressure, or whether a low-pressure system shall be installed throughout We must consider the desirability of returning the condensate to the boiler house for boiler feed, and decide whether it would pay to install a vacuum system or a high-pressure drip system. Care should also be taken to install drips and traps to drain low points, so that there will be no accumulation of condensate to cause water hammer.

In the case of electrical distribution the line losses must be reduced to a minimum consistent with the investment necessary to install a distribution system that will deliver the required voltage at the load.

A distribution system for service lines is a comparatively simple affair in plants where the buildings are adjacent to the boiler house or power plant, for it is possible to construct a small tunnel and run the lines into the basements of the adjoining buildings, taking off from risers the power, air, water and so on required by each department.

> How the design in detail should be undertaken if the object is to reduce losses to the minimum consistent with economy, and to provide systems (piping, wiring feeders and other services) that will be free from complicated arrangements subject to breakdown.

* * * *

The use of a tunnel for carrying pipe lines has much to recommend it in view of the ease of installing the piping, and the accessibility for repairs. Also, piping can be given the maximum amount of insulation to reduce the steam losses, and there is ample room for installing traps and other accessories.

To be sure, conduits, water, compressed air and other lines can be supported on the ceiling or walls of buildings at minimum expense, but with this system there is involved a fire hazard which is not always considered, especially when slow-burning mill construction or frame buildings are used. Frequently, the main lines of various services are hung in the basement of frame buildings, before being distributed to the different portions of the plant. Should a fire occur in these buildings the entire plant would be crippled until the lines could be put into service again.

Connecting a boiler plant or power house to a series of scattered buildings which may be several hundred feet away is an entirely different problem. Fortunately, however, steam losses can be so reduced through effi-

cient insulation that a loss of not over 5 to 10 per cent should be suffered on an extremely long line of piping, regardless of the steam pressure.

If a tunnel is used for carrying the service lines, reinforced concrete forms the most practical and permanent type of construction.

A pipe tunnel should be designed of sufficient size to inclose all piping, wires, and other service systems and still leave room for mechanics to use the required wrenches or make such repairs as become necessary.

I would recommend that a tunnel be at least 6 x 8 ft. or 8 x 8 ft. in size, unless single systems or small pipe lines are being used. Care should be taken in choosing the foundation for such a tunnel so that it will not settle. In wet locations effective measures should be taken to make the tunnel dry. At the time the tunnel is constructed, a sufficient number of anchors or bolts should be placed to secure the hangers that fasten the piping and cables to the various portions of the structure. Care should also be used in locating the various systems themselves in the tunnel, so that there will be no confusion as to the location of valves, traps, junction boxes, expansion joints, and the like.

The entire installation should be designed in detail and each individual pipe traced through its entire length to make sure that it does not cross or conflict with other portions of the work. Special care should be given to the design of hangers, so that there are proper expansion and contraction allowances. Anchors should be securely fastened to the side of the tunnel, and expansion joints and bends provided at the proper places to counteract any possibility of excessive strain arising in the piping due to the variation in length caused by expansion.

It is good practice to place the steam lines on the sides of the tunnel. The electrical wiring may either be imbedded in the concrete roof in hollow tile ducts or run in steel conduit. When it is supported from the ceiling of the tunnel in steel conduit, repairs or connections can readily be made. All piping in such tunnels should be thoroughly insulated, especially the flanges, to reduce condensation and lessen any drop in pressure at the process machinery or reducing valve.

Each tunnel system should be properly drained to eliminate any possibility of flooding. Pumps are usually provided to remove the water which will necessarily gravitate to the low point in the tunnel, should the basements become flooded, due to opening of sprinklers or otherwise. Where tunnels are used to connect basements of buildings, firedoors should be placed at each entrance to prevent the possibility of fire passing from one building to another.

Some form of ventilating system should also be provided to create constant circulation; otherwise the air will become very stifling.

Although the construction of pipe tunnels is expensive they are permanent and when once installed will never have to be replaced. This method of distribution adds to the life of the piping, wiring, etc., and provides accessibility for repairs.

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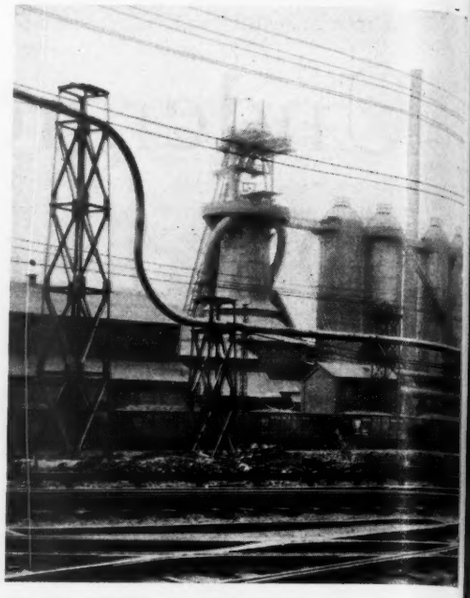
SPLIT TILE CONDUIT provides an economical method of protecting pipe lines for carrying steam long distances.



PIPE LINES suspended from structural steel supports are extensively used for the distribution of high-pressure steam.

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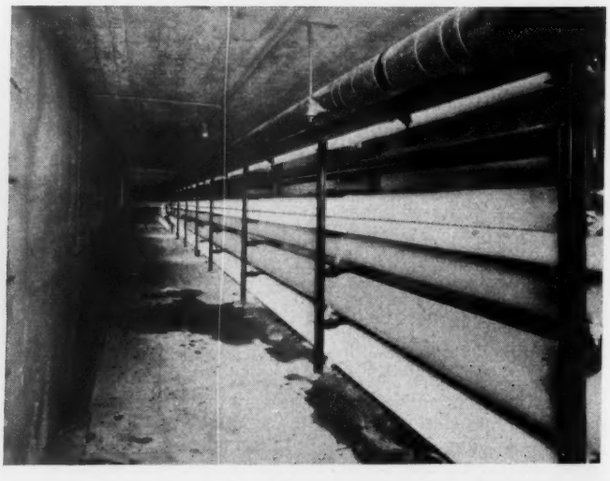
IF THE PROPER INSULATION is used, steam can be transmitted long distances with minimum loss regardless of wind or weather.

ACCESSIBILITY and ample room for running additional lines in the future should be carefully considered in the design of a pipe tunnel.



When steam lines are not carried through a tunnel or in the basements of the buildings, split tile conduit or wood casings can be used for distributing them throughout a scattered plant. The electrical distribution system should either be put underground or carried on poles. Water service mains can be laid directly in the soil, provided the necessary precautions are taken to protect them.

Adequate under-drainage for all portions of the pipe line is the first important requisite for steam piping laid underground in tile or wood casing, so that it will be impossible for water to back up around the conduit. When water enters the incasing conduit the insulation is damaged and soon disintegrates.

A secure foundation must be obtained to support the conduit ducts and the cradles or pipe rolls upon which the pipes themselves rest. This will insure positive alignment of the piping so that the proper grade and drainage may be maintained. In this type of installation close attention should be paid to the compensation for expansion and contraction of the lines, and the layout of valve pits. Distribution feeders are usually taken off the pipe lines through a series of manholes or valve pits leading to each individual building.

Connections for future extensions should also be provided at numerous points so that possible additions to the plant can be made without digging up the entire feeder. Care should likewise be used in designing the pipe line to insure adequate size, so that there will not be an excessive drop in pressure due to frictional losses.

It is advisable to consider carefully the application of the welded joint in place of flanged fittings for underground pipe lines. This type of joint is fast being adopted in modern applications and frequently can be installed at less expense than the old-type Van Stone joints or flange fitting. This is particularly true in the case of steam, water, and gas lines.

The insulation of the piping inside the tile conduit or wood casing is extremely important. After the pipe has been installed and thoroughly tested for leaks, there are two methods of insulating it: first, by the application of sectional pipe covering of the required thickness to reduce condensation losses to a minimum; second, through the use of sponge asbestos filling which packs closely around the pipe inside the conduit.

Care should be taken to see that the top of the split tile section is placed with thoroughly cemented joints so that there can be no possibility of water entering the line. The same precaution also applies when wood casing is used.

When these conduits are laid below the frost line and, in some cases even above the frost line, it is possible to obtain distribution with very little loss. A practical test of the efficiency of the insulation can be made during the winter period by observing whether the snow has melted over the line. You may be sure that if snow stays on the ground over such pipe lines throughout the entire winter, you will have a minimum amount of loss.

Steam lines, both high and low pressure, may be supported above ground on a steel structure or wood poles. This method has recently been used for long lines of pipe run-

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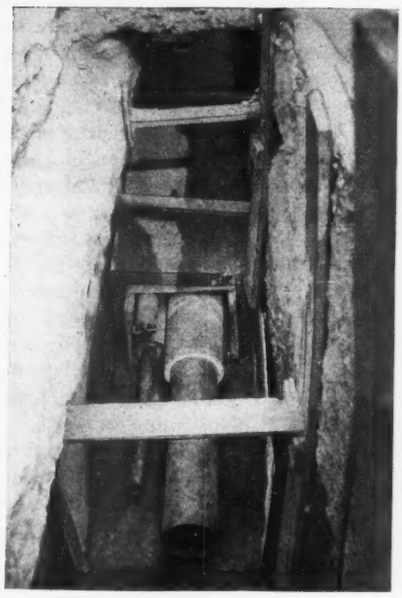

SPECIAL HOUSINGS of concrete can oftentimes be used to good advantage, when the piping is well insulated.

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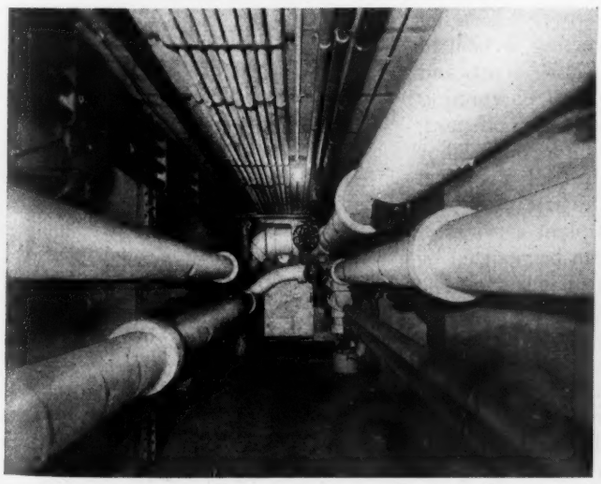
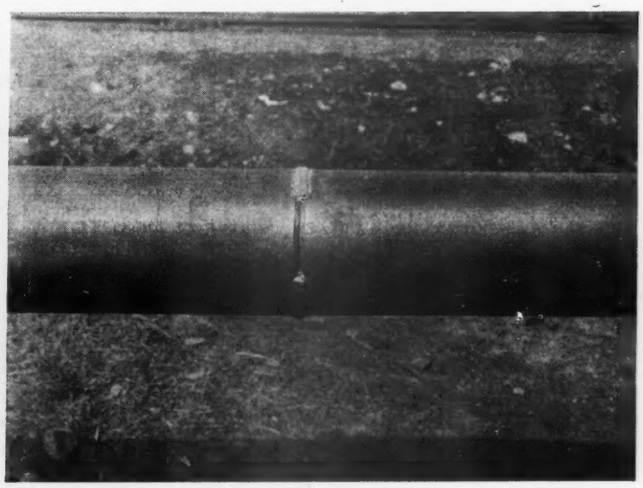
PIPE HANGERS present many problems in careful design to obtain strength and sufficient adjustment to compensate for expansion and contraction.



WELDED JOINTS are rapidly being adopted for all kinds of pipe lines, and in general they appeal to practically every maintenance man.



ning to scattered buildings, as it is less expensive than putting the pipe underground, and with modern insulation the line losses can be reduced to at least 10 per cent, even when the lines are carrying superheated steam in zero weather. This overhead construction would be impractical, however, where it is desired to return the condensate, unless pumps were used to force the water over the various grades that are encountered, or there was a gravity feed directly from the factory to the power house.

On overhead pipe lines care should be taken to insure proper drainage, and drip pockets and traps installed to provide for condensate collection. In addition to this, extreme care should be used in laying out expansion bends, expansion joints, and hangers for supporting the pipes, so that unnecessary strains will be eliminated. The most important part of this overhead system of distribution is the insulation; unless this is of high quality and properly applied heavy losses that will result will make this method of distribution expensive. On the whole, these long overhead pipe lines are advisable only where high-pressure steam is to be carried long distances for reduction at the individual receiving plant.

All industrial plants have a central distribution switchboard from which feeders are run to the various buildings or departments. Whenever it is necessary to supply buildings or departments in remote sections of the plant, feeders can be run underground or overhead on pole lines. For permanent construction, it is advisable to either use fiber or steel conduit and pull in lead cable running to the various buildings. This is a rather expensive construction, but it is permanent and eliminates all chances of breakdown.

I have found that in some instances it is cheaper to purchase steel-armored cable, rather than go to the expense of laying steel conduit and then buying cable with a lead covering. The labor saved by the installation of the steel-armored cable more than offsets the difference in the cost of the system.

Pole lines, however, are standard for long-distance transmission in industrial plants, and if set up in the proper manner will give reasonably satisfactory and reliable service at moderate cost. Care must be taken, however, to provide feeders that will withstand the heavy overloads encountered in industrial plants, and they should be carried on steel, concrete, or wood poles that are properly supported and guyed.

The various distribution systems for every industrial plant should be planned with care; and above all, accurate plans should be made of all underground distribution systems. How many times we have gone into an old plant or building and been unable to trace the pipe lines from one building or place to another, or have come to an open drain and found four or five different pipes entering it, but no one seemed to know where they came from! Oftentimes in such cases even some of the old-timers about the plant do not know where the various systems originate. It pays to keep accurate drawings of all systems, showing the location of valves, manholes, drains, sewers, catchbasins, tunnels, water, gas, air and steam lines, and electrical systems. In emergencies detailed drawings are invaluable, as repairs can be made without loss of time.

WHEN making up such a drawing, show each system in a different-colored ink. This will make it easier to trace out each line quickly.

Those who have not had experience with large installations in industrial plants, do not realize the multiplicity of pipe lines above and underground. This is especially true in cases where the plant has grown rapidly and changes have been made without careful planning in detail.

The engineering department of an industrial plant should use extreme care in choosing pipe sizes and wire capacity, making adequate allowances for future growth on extended lines. It is extremely expensive to increase feeders after they have been installed.

In the case of plants that have scattered buildings with isolated boiler or power plant, I would recommend that a thorough study be made of the entire distribution system to determine the possibility of erecting a central plant for supplying heat, light and power. When a plant is running many scattered units with inefficient, small engines, and at excessive labor cost, it will pay to install a central plant with adequate distribution systems for the various plant services.

The savings that can be realized by efficient transmission of power and so on are not always appreciated by the management. Under the old-time system a separate boiler or power plant was provided for each individual factory. This arrangement is gradually being eliminated in large plants, with resulting increase in efficiency.

Points on the Selection of Welding Rods

WHAT should be the determining factors in the choice of one welding rod in preference to another? In the early days of welding almost any sort of wire was used provided it filled the hole and was strong enough to hold the material together. Today, however, the requirements are much more stringent due to considerable specialization in welding rods.

The best welding rods on the market today represents the result of years of exhaustive research and experiment. When a welding rod is subjected to the welding process it undergoes not only a physical, but also a chemical change, according to a statement by a leading manufacturer of accessory welding equipment. Various oxides are formed which should come to the surface of the molten metal and form a protective coating to prevent oxidation of the metal. Since the majority of the work encountered is V-ed out to facilitate the deep and perfect fusion of the pieces it is imperative that the weld metal supplied by the welding rod should be of the best quality in order to produce metal that will have equal reliability to the rest of the metal in the joint. When a welding rod of poor quality is used, the resulting weld will have slag or oxide inclusions.

It is very important that the welding rod chosen should have a strength equal to or greater than that of the material being welded. This is obtained only by the use of a good quality rod. Another consideration, which at first seems petty, but which assumes a greater importance in handling large quantities of rod is matter of readily identifying the various rods. The different types of rod should be marked so as to be readily distinguishable, one from the other.

TO SUM up, the characteristics or factors which should be considered in choosing a welding rod may be tabulated as follows:

(1) A composition such that the resulting weld metal will have the proper chemical and physical properties with respect to the base metal.

(2) A composition such that the metal will flow readily and smoothly.

(3) The rod should be marked in some way so it can be readily and accurately identified.

(4) The rod should be purchased from a reputable manufacturer who can guarantee its quality and uniformity.

V. E. JOHNSON [in the first article of a series]

describes the

Elements of Commutation

THE past 10 or 15 years have seen radical improvements in the design and construction of direct-current machines. Losses have been reduced, coil failures minimized, and the output per pound increased. The outstanding achievement, and the one that perhaps appeals most to the operator, is the improvement in commutation. The purchaser today expects and receives a machine that operates satisfactorily under any condition within its rating and shows no great distress even under extreme load swings.

Commutation is essentially the process whereby the alternating current flowing in the armature coils is reversed at every half cycle, so as to be delivered into the feeders unidirectionally. From this standpoint the commutator and brushes form a simple reversing switch. The difficulties that had to be overcome in developing these parts to their present highly effective form are not at once apparent; nevertheless, they form an interesting and instructive chapter in the history of d.c. machinery.

For a good many years it was quite generally assumed that the whole subject was essentially independent of exact engineering, and empirical methods were largely used in the selection of materials and designs. That machines built under such conditions operated successfully was due to the universally liberal ratings that prevailed, and to the fact that many of the haphazard principles used turned out to be basically sound.

To avoid needless repetition, the following discussion and analysis are specifically applied to d.c. generators, although motors have corresponding characteristics and are subject to the same basic rules. In a generator the brushes are shifted forward, and in a motor backward, but the underlying cause, armature reaction, is the same.

In its simplified form, a d.c. generator consists of a single loop of wire revolving in a magnetic field, and having its terminals attached to the moving segments of a commutator. This is shown in Fig. 1. The direction of the flux, of the generated voltage, and of the resultant current flow is shown by the arrows. When the plane of the coil is in the position *AA*, no magnetic lines of force are being cut and the voltage drops to zero. At this instant the brushes "trade" segments sparklessly, because no current is interrupted.

If the brushes are shifted so that commutation occurs while current is flowing, there will of necessity be sparking and flashing. Not only is the load current broken, but a momentary short circuit is imposed on the coil, due to the brushes spanning the gap between the segments.

The amount of this sparking will be determined by:

(*A*) The angular displacement from the neutral points.

(*B*) The amount of load current.

This will, for a given brush displacement, depend upon the resistance of the external circuit.

* * * *

FIG. 1—SIMPLE ARMATURE AND COMMUTATOR. Light arrows show the direction of magnetic flux, generated voltage, and current flow. The heavy arrow shows the direction of the armature flux.

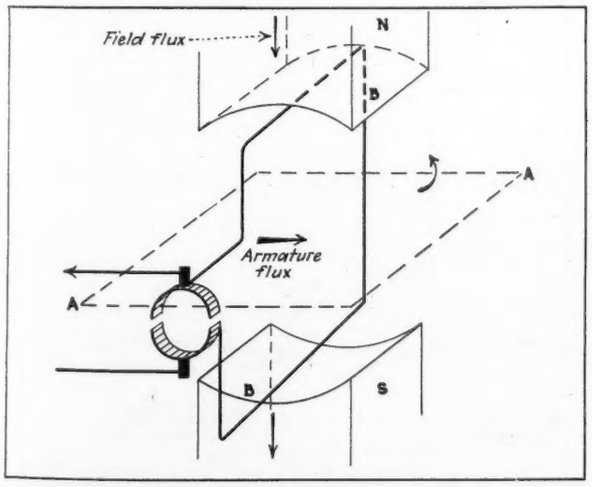
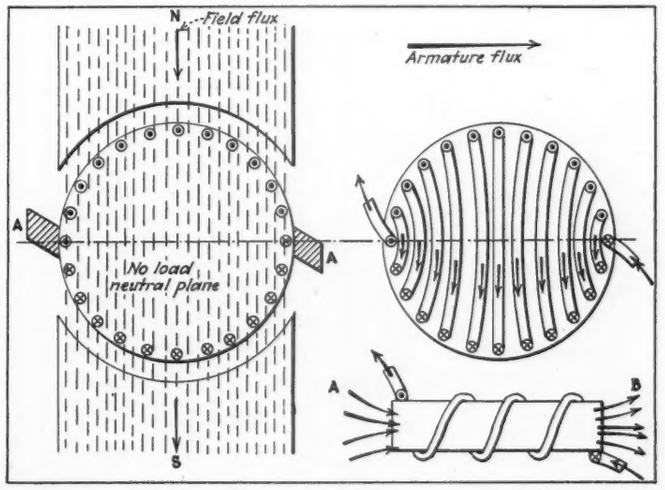


FIG. 2—AN ARMATURE IS AN ELECTROMAGNET WHEN UNDER LOAD. The crosses and dots represent currents flowing down and up, respectively, through the paper. This is a two-pole, drum-wound armature.



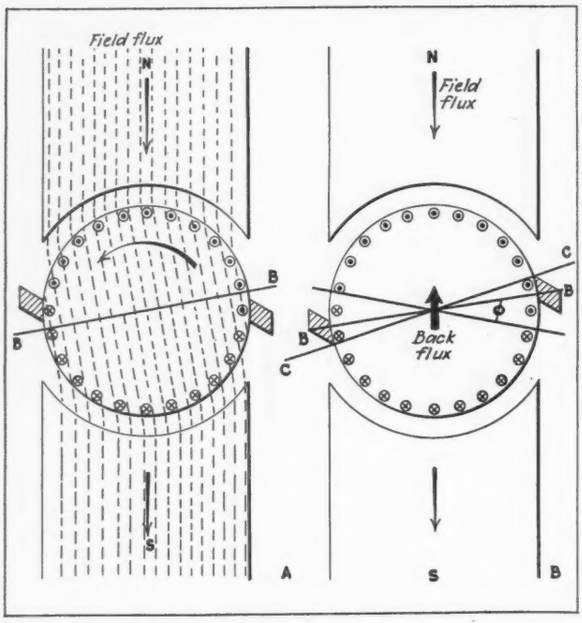


FIG. 3—FLUX DISTRIBUTION OF TWO-POLE MACHINE UNDER LOAD In diagram *A* the load neutral is along line *BB*. Moving the brushes to this neutral, diagram *B*, sets up a back flux, indicated by the heavy arrow.

* * * *

(*C*) The amount of short-circuit current.

For a given brush displacement this will be a fraction of the self induction of the armature coil, and of the coil, brush and contact resistance.

If the external circuit were opened there would still be sparking, due to the periodic short circuiting of the armature coil. This could be reduced by introducing a resistance into this local circuit. Obviously, the only logical place for it would be in the face of the brush, for here it would offer obstruction only to the flow of current between segments during commutation. The mechanical difficulties in introducing such a resistance into the brush face are avoided by using non-metallic brushes, such as those made of carbon or graphite.

Increasing the resistance of the brushes would permit greater displacement without destructive sparking, but improvement by this means is limited by the fact that this would also impede the flow of current into the external circuit.

The plane *AA*, Fig. 1, in which the coil cuts no flux and therefore generates no voltage, is not necessarily symmetrically located with reference to the pole structure; in a machine the magnetic lines are never parallel, and are usually asymmetrical.

If the coil in Fig. 1 were held stationary in plane *BB* and separately excited, a magnetic field having a value determined by the ampere-turns would be set up in the direction shown by the heavy arrow. Under actual operating conditions the same thing would be true, for the load current would produce a similar, cross-magnetizing effect. Inasmuch as the main field ampere-turns are of approximately constant value, considerable distortion is introduced by the changing armature flux. The neutral plane, therefore, occupies a variety of positions, each of which requires a different brush adjustment.

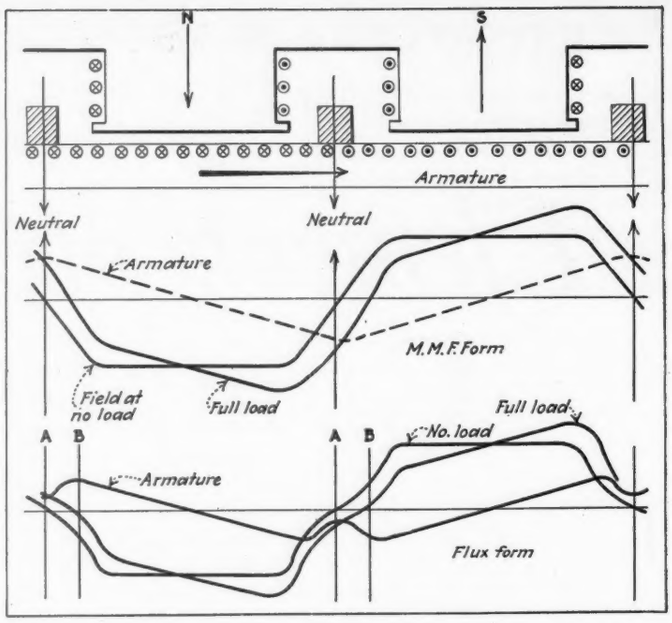


FIG. 4—FORM OF MAGNETOMOTIVE FORCES AND FLUX DISTRIBUTION. Under load the field is distorted and the neutral shifted from *AA* to *BB*.

* * * *

Fig. 2*A* shows in more detail the flux displacement in a two-pole, drum-wound armature. The type and general arrangement of the end connections between the armature conductors have no effect on the ampere-turns; so it may be assumed that the winding has a spiral form, as in Fig. 2*B*, and, therefore, is simply a plain electromagnet excited by the load current flowing through it.

* * * *

FIG. 5—THIS DIAGRAM shows what is meant by a "wide commutating zone."

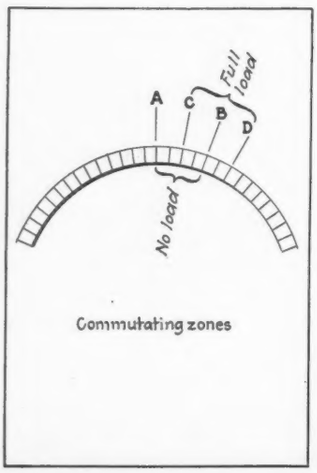
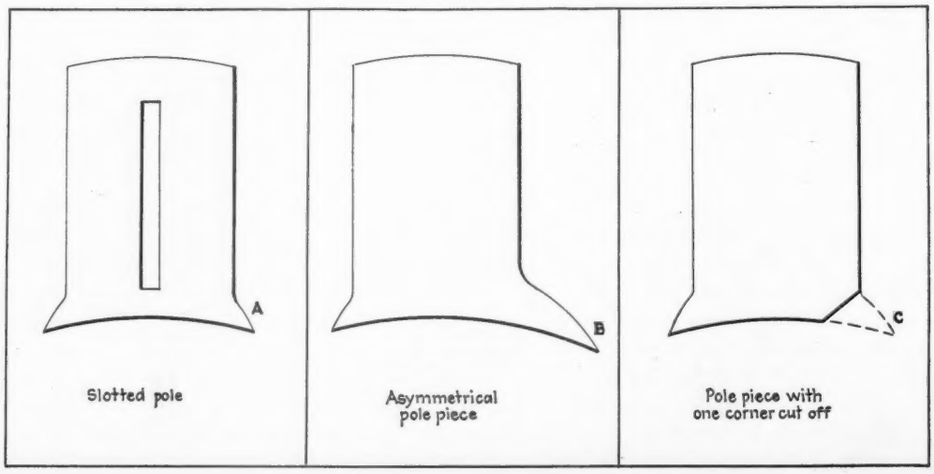


FIG. 6—EARLY METHODS of minimizing effect of armature reaction.



This may seem confusing at first, but it should be remembered that the position of the brushes definitely locates the axis of the armature flux. In effect this magnetism stands still as the armature iron slides through it.

At no-load, the armature is merely an inert path for the lines of force flowing from the north to the south pole. The neutral plane *AA* is then symmetrically located with reference to the pole structure.

Under load, the combined effect of the field and armature ampere-turns results in a flux form like that in Fig. 3*A*, with a load neutral at *BB*, to which the brushes must be moved. Shifting them to this position (see Fig. 3*B*) introduces a new component into the armature ampere-turns, for now all of the coils in the angle ϕ set up a flux which directly opposes that of the main poles. This back magneto-motive force is indicated by the short, thick arrow pointing upward.

The voltage generated is, among other factors, proportional to the total flux through the air gap. With the brushes at neutral, the total number of lines remains unchanged, but with an advanced brush setting there is a decreased air gap flux and reduction in terminal voltage. Weakening of the main field permits the neutral to shift still farther, so that the final position is at some point *CC* as shown in Fig. 3*B*.

In order to show more clearly the flux distribution in the air gap, so-called field form curves such as in Fig. 4 may be drawn. These show the magneto-motive forces (M.M.F.) for the field, armature, the two combined, and the corresponding flux forms.

* * * *

FIG. 8—FLUX FORMS for interpole generator at no-load and full load.

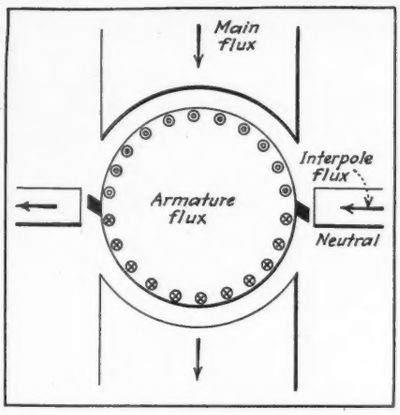


FIG. 7—THE FLUX from interpoles opposes that produced by the armature.

* * * *

At no-load the curve is symmetrical and of uniform value across the pole faces. When load is applied, the field is distorted by the cross-magnetizing effect of the armature magnetism and the neutral line is shifted from *AA* to *BB*. With the brushes in the position shown, the total magneto-motive force is unchanged, for the armature M.M.F. adds to one side exactly as much as it subtracts from the other. The total flux will, however, change slightly, due to saturation of the iron at the points where the density is increased.

Actually, the shifting of the neutral necessitates a corresponding movement of the brushes in order to obtain satisfactory commutation. This movement destroys the symmetry of the armature M.M.F. with respect to the main fields; the demagnetizing loops become larger than the magnetizing loops and the total air gap flux is reduced. This corresponds exactly to the condition shown in Fig. 3. The effect on the voltage of the generator is approximately that of a reversed compound winding.

Although satisfactory commutation can be obtained by shifting the brushes to correspond to load conditions, engineers tried from the beginning to eliminate the need of constant attendance.

One of the earlier attempts employed an electro-magnetic device by means of which the brushes were automatically advanced an angle which corresponded to the load. This arrangement was promptly abandoned and efforts directed at curing the cause, rather than the symptom.

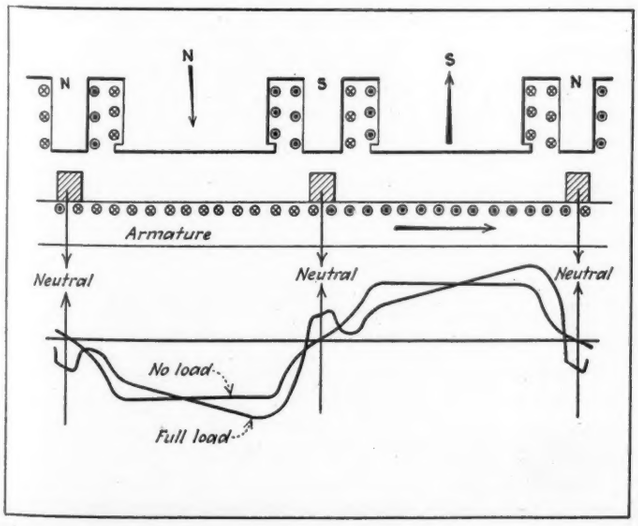
It was obvious that a very stable main field would minimize the effect of armature reaction. This led to the use of larger air gaps. These introduced reluctance into the magnetic circuit of the main fields and armature alike, but it was a simple matter to increase the excitation to maintain the voltage, whereas the armature ampere-turns, being a function of the load, remained the same.

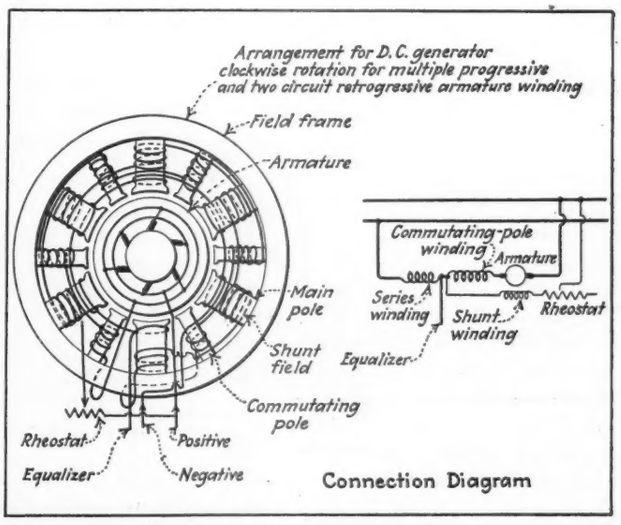
The use of high-resistance brushes increased the leeway and made it possible to operate many machines at any load without the necessity of adjustment. Such apparatus having a "wide tors of this type are in use today.

The importance of the wide commutation zone is evident from Fig. 5, which shows a section of a commutator near one set of brushes. The no-load neutral is at *A*, but the machine will operate idle with a setting between *A* and *B*. The full-load neucommutating zone" gave very good service and many generators and motral is at *C*, but the unit will carry its rating without sparking anywhere be*C* and *D*. Between *C* and *B* is a narrow zone that is satisfactory for any load condition. The width of this

* * * *

FIG. 9—CONNECTION DIAGRAM of generator with interpoles.





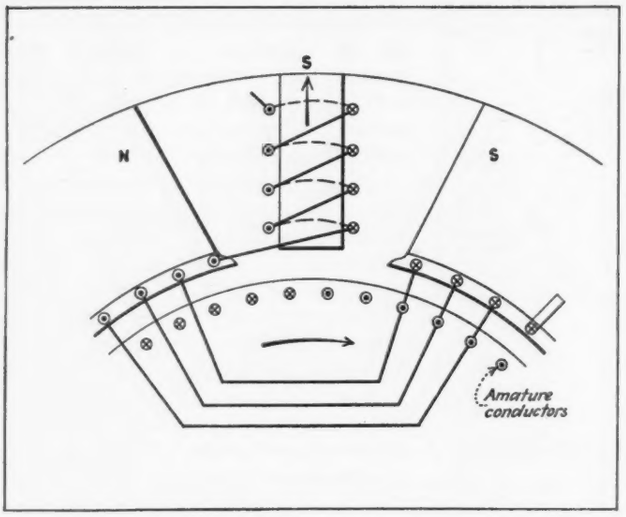


FIG. 10—METHOD OF DISTRIBUTING part of commutating winding over main pole faces.

* * * *

overlap determines whether difficulties will be encountered in obtaining sparkless commutation. If zone *CB* narrows down to a point, extremely accurate adjustment will, of course, be necessary.

The ratings of machines of this type were ordinarily limited by the commutation and not by the temperature rise. Increasing loads would in any event finally eliminate the overlap *CB;* ultimately the distortion would be too great to permit operation with any setting. Under extreme conditions the back ampere-turns would reduce the voltage to zero or even reverse the polarity of the machine.

Many attempts were made to minimize the effect of armature reaction. One of them consisted in designing the poles with radial slots that introduced reluctance into the armature circuit, but had comparatively little effect on the main field. Fig. 6*A* shows this arrangement.

Another scheme was to distort the no-load field so as to compensate for the effect of the armature flux. This was done in various ways, one of which is shown in Fig. 6*B*. A machine of this design could be run in only one direction.

Another scheme is shown in Fig. 6*C*, in which unsymmetrical punchings were assembled so as to increase the saturation of the pole tips by reducing the iron cross-section.

All of these schemes had some value, and some of them resulted in commercially successful machines. They had, however, two basic shortcomings that demanded a remedy. (1) The compensation provided by them was necessarily a compromise among the various loads that had to be carried. (2) They all required a brush position that was displaced from the no-load neutral and, therefore, materially affected the characteristics of the machine.

The next step was the use of auxiliary poles, now usually called interpoles or commutating poles. These were connected in series with the armature so that their strength and hence their compensatory effect was at all times approximately proportional to the load current. Fig. 7 shows these interpoles applied to a two-pole machine.

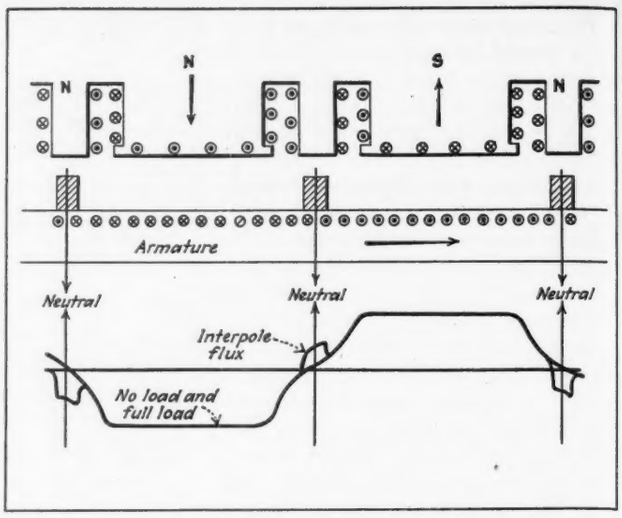


FIG. 11—FLUX FORM of completely-compensated generator. Full load and no load curves are almost identical.

* * * *

Fig. 8 shows the field form and Fig. 9 the connection diagram of a generator with commutating poles. The neutral position is approximately the same, regardless of the load, although complete neutralization cannot be obtained. The interpolar design is, however, very satisfactory and is standard today on all small and medium-sized machines.

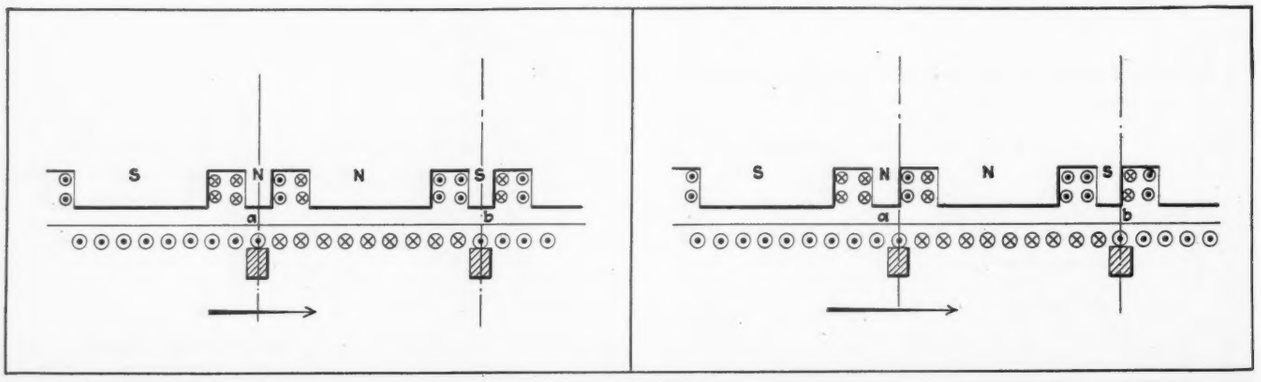
Fig. 8 shows that the commutating-pole design, although it stabilizes the neutral, and obviates brush-shifting, does not completely compensate for the magnetic reaction resulting from the load current in the armature coils. It is evident, too, that the voltage per commutator bar must fluctuate as the conductors sweep

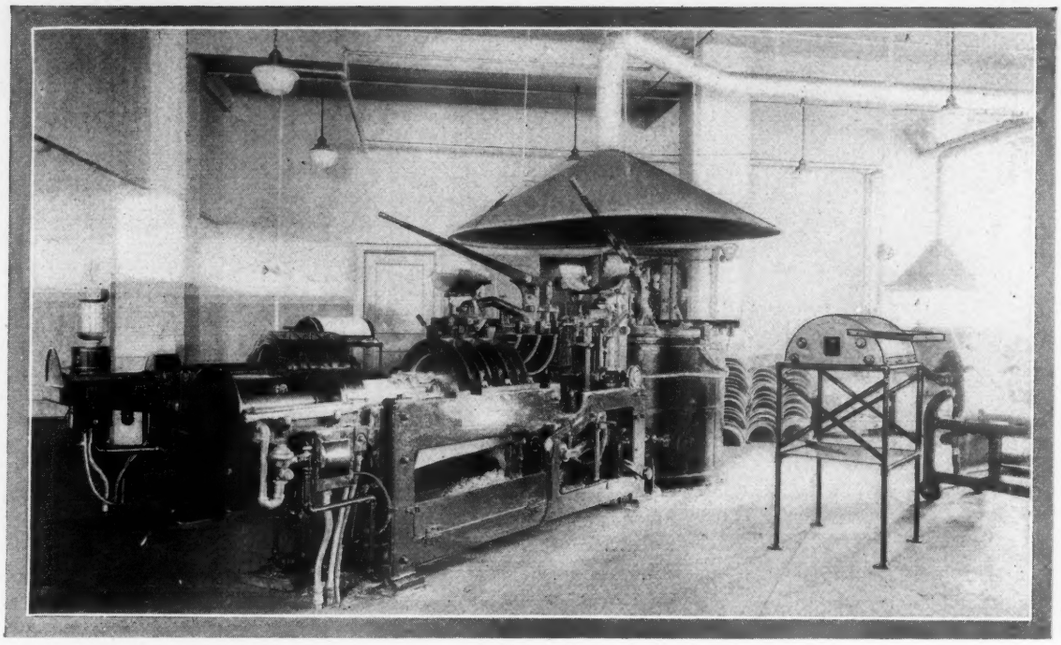
(Please turn to page 190)

* * * *

FIG. 12 — ON INTERPOLE AND COMPENSATED MACHINES THE BRUSHES SHOULD BE ON NEUTRAL
In this case the coils cut the flux from a main pole located, in effect, between two half-interpoles of opposite polarity.

FIG. 13—SHIFTING THE BRUSHES FORWARD WILL CAUSE THE LOAD-VOLTAGE CURVE TO DROOP
With the brushes shifted forward, as shown here, the flux cut by the coils is equal to the difference between the main pole and interpole fluxes.





Electrically-heated stereotype metal furnace in newspaper plant

A study of the requirements of

Electrically Heated Melting Pots

for soft metals

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Industrial Heating and Welding Engineering Department
General Electric Company
Schenectady, N. Y.

MELTING pots are used very widely by industiral plants for melting soft metals, such as tin, lead, solder and babbitt metal, and also by newspaper and other publishing plants for melting and remelting the metal plates or cylinders from which the printed impressions are taken.

Printing plants in particular, are large users of this equipment, and in order to meet their requirements, heaters suitable for typesetting machines, stereotype and electrotype pots, and so on, have been developed so that there is now available either electrically-heated apparatus complete in itself or types of electric heaters that can be applied to almost any process involving the melting of soft metals.

Such apparatus was formerly heated by combustible fuels, principally gas or coal. The fuel was burned outside the crucible, requiring relatively high furnace temperatures, and stacks were necessary to carry away the products of combustion. Temperature control was obtained by regulating the fire or flame by hand, requiring considerable attention from the operators and yielding uncertain results.

The walls of modern, electrically-heated pots are well heat-insulated; therefore, the external temperatures are low, and automatic control maintains the metal always at the correct temperature. There are no fumes or gases in the atmosphere, room temperatures are more comfortable, and no attention is required from the workmen except to replenish the metal as it is used.

For general use, such as melting tin, lead, solder and babbitt, modern pots are constructed with a cylindrical casing or jacket of steel plate and a crucible of cast iron. The space between the jacket and the crucible is packed with a high-grade heat-insulating material, and the heating units are placed inside the crucible, in direct contact with the metal to be melted. A typical cross-section of a pot is shown in Fig. 1 and the complete pot in Fig. 2.

The units for these pots are formed of what is known as "helicoil sheath wire," consisting of a helix of nickel-chromium wire, which carries the electric current, inclosed in a steel tube, the space between the turns of the helix and between helix and sheath being solidly packed with a dense electrical insulating material. The unit is then bent or formed to the required shape, placed in a mold, and molten cast iron poured around it, after which a terminal cover or conduit box is welded on.

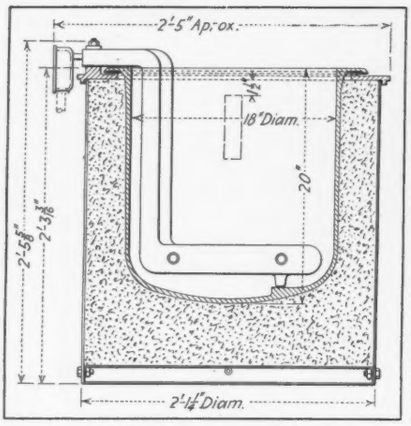


FIG. 1—CROSS-SECTION of melting pot with immersion heating units. This pot is equipped with three 5-kw. units and will hold approximately 1,200 lb. of solder.

FIG. 2—A TYPICAL MELTING POT using immersion heaters. One heating unit is rated 1,500 volts and the other 1,000 volts. The capacity is 100 lb. of solder.

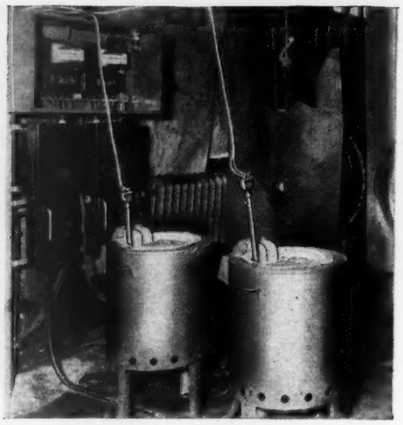


FIG. 3—MELTING POTS with automatic control. One pot is used for melting tin, and the other for babbitt. The pyrometers and control equipment can be seen at the left.

* * * * * * * *

These units can be made in various sizes and wattages as required, and one or more units used as required, depending on the size of the pot. For pots having two units, these are usually of different capacity, so that either the smaller or the larger unit can be switched off when the metal has reached temperature. This arrangement gives a three-heat range, as both units may be used to bring the metal to temperature and either one of them for holding, depending on the temperature required. This scheme is applicable when the expense of automatic control is not justified. Automatic control is, however, recommended for larger pots, as the cost is then proportionately less, particularly if the pots are to operate above 850 deg. F.

When hand control is desired an inclosed safety switch is used for each of the two heating units.

When automatic control is used, the equipment consists of the pot, an automatic control panel, and a thermostat or temperature control instrument with its thermocouple projecting into the molten metal. Such an equipment is shown in Fig. 3.

Pots with these heating units can be operated at any temperature up to 950 deg. F., but for temperatures above 850 deg. F. automatic control is recommended, as it is not advisable to operate with hand control near the maximum rated temperature of the units. Lack of attention on the part of the workmen might cause damage to them.

This type of heating unit is made in various forms for installation in shallow pots such as are used for tinning steel, and copper wire, and strip, for soldering operations in the manufacture of cans, for deep pots such as are used in the manufacture of tinplate and for melting lead, babbitt and stereotype metal in large quantities.

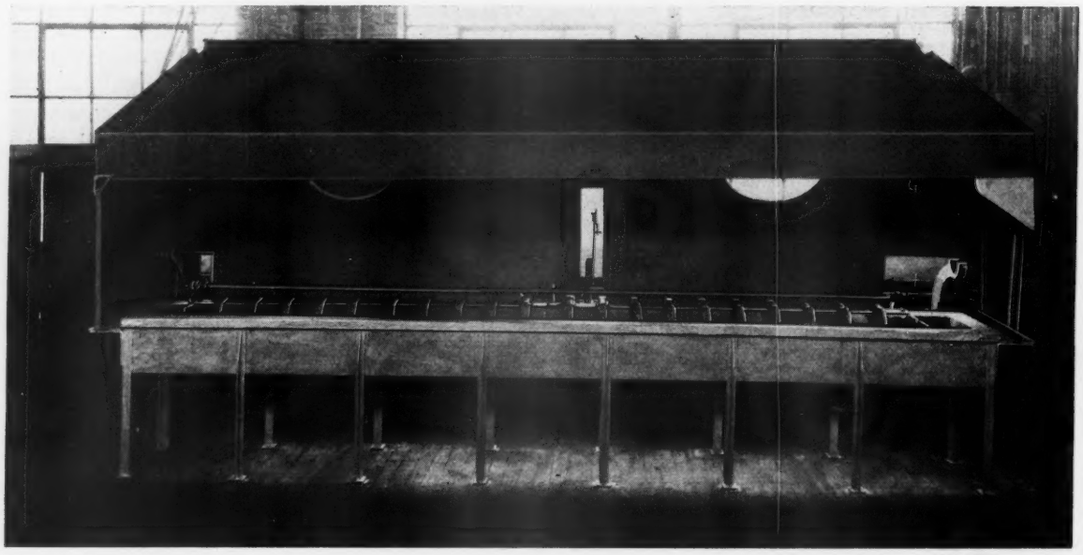
The units are strong mechanically and are rated conservatively to give a long service life. The terminals are fully protected from mechanical injury, or from spilled metal or creepage of flux, by the conduit box which is welded on. Furthermore, they are or may be readily adapted to fit in present fuel-fired pots. Such equipment can, therefore, be changed to use electric heat at a very low cost, and with little trouble or delay.

Fig. 4 shows a pot used for tinning long tubes. Fig. 7 is a cross-section of it, showing the simple construction of pots of this type. A movable partition or division wall is used with this pot so that when short tubes are to be tinned only a portion of the pot need be heated.

Such pots can readily and quickly be built at low cost by any manu-

* * * *

FIG. 4—TINNING POT FOR LONG TUBES. This pot is equipped with twenty immersion heaters.



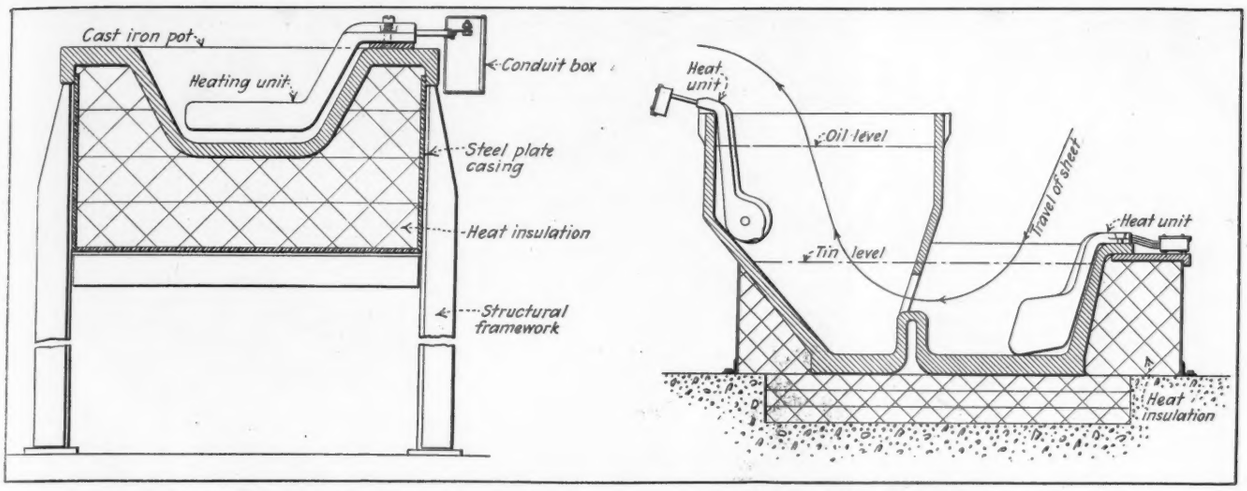


FIG. 5—DIAGRAM of typical pots used in the manufacture of tin plate.

FIG. 7—CROSS-SECTION of the long-tube tinning pot shown in Fig. 4.

* * * *

facturer, to meet his particular requirements. They are self-contained, light, and portable, and embody the most advanced ideas applicable to such equipment. The portable feature may well be emphasized, as it will save both the time and the cost of rebuilding in case a rearrangement of machinery is found necessary.

Another great advantage is that all temperatures are low, no higher than the molten metal itself, so that expansion strains are reduced to the minimum, and the possibility of cracking the pot is eliminated.

Fig. 6 shows a pot of 5 tons holding capacity used for melting lead. It is heated by six units of 5-kw. rating each, and produces approximately 1,000 lb. of lead per hour at 750 deg. F.

Pots used in the manufacture of tinplate are about 6 ft. long x 3½ ft. wide, and contain about 11,000 lb. of molten tin. They have a central division wall on the back side of which a deep layer of palm oil floats on the surface of the tin. This oil has been found to give the sheets the required surface finish.

About 20 units of 5-kw. rating each are installed on the entrance side, and 5 units, or 25 kw. capacity, on the oil side, the latter being used only to bring the oil to the proper temperature for starting. When the pot is in operation sufficient heat is carried through by the sheets to keep the oil at the proper temperature. Fig. 5 shows a typical pot in diagram.

By the use of immersion units, the usual high external temperatures are eliminated, and instead the sides and bottom of the pot can be well covered with heat insulation. This makes it much more comfortable for the workmen as they must stand close to

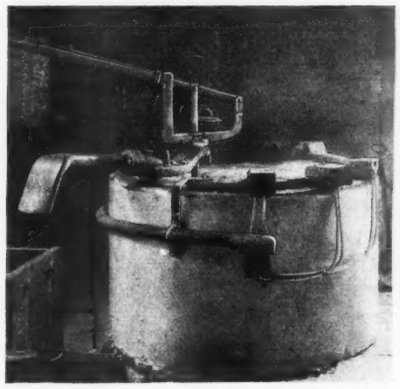


FIG. 6—THIS POT has a capacity of 1,000 lb. of molten lead per hour. It is equipped with six, 5-kw. immersion heating units and will hold about 5 tons of metal.

* * * *

the pot, and the automatic control of temperature allows them to devote their entire attention to feeding the material through.

These pots will give an output of about 575 "base boxes" per 24-hour day, with an energy consumption of 3.8 kw.-hr. per base box for sheets

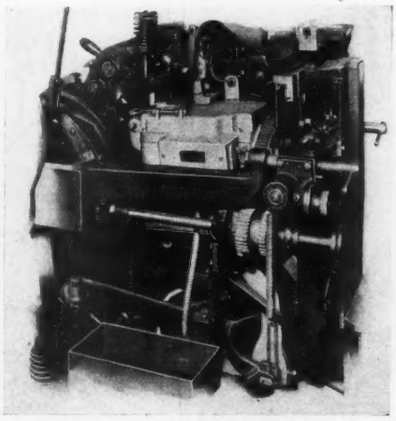


FIG. 8—TYPE-SETTING MACHINE with electrically heated melting pot. The automatic control is mounted on top of the pot, at the back.

* * * *

of average thickness. (This unit of measurement, base box, represents 112 sheets 14 in. x 20 in., or 31,360 sq.in. of any size. The weight is about 100 lb., depending on the thickness of the sheets.)

A pot will, therefore, consume about 2,200 kw.-hr. per 24-hour day, and as they usually operate continuously day and night, it is an ideal load from the central station viewpoint. It is a thoroughly practical application and at the usual prevailing rates for fuel and electricity should show a substantial saving, although most mills engaged in the manufacture of tinplate are located near the coal and natural gas supply, and many have coke oven gas available at low cost.

Under these conditions the heating cost with electricity is somewhat higher, but due consideration should be given to the fact that furnace repairs and cracked pots are eliminated, with their attendant costs and delays in production. For this reason a greater output can be secured per pot, and for a given investment in equipment.

The market quotations on tinplate are about $5.50 per base box, and at 1 cent per kilowatt-hour the cost of heat for tinning would be 0.7 per cent of the price. The difference in cost between electric heat and fuel would be very small, and in some plants would undoubtedly be in favor of electric heat when all factors are taken into consideration.

The newspaper industry is without doubt the largest single user of soft metal melting equipment. The application can be considered only briefly here.

Fig. 8 shows a melting pot mounted on a typesetting machine. A line of

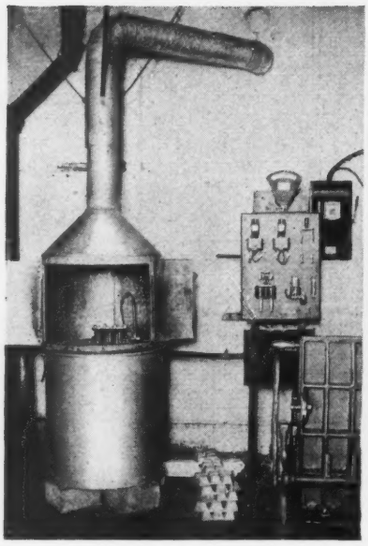


FIG. 9—REMELTING POT for type metal in a newspaper plant. This pot operates at a temperature of 650 deg. F. and its rating at this temperature is 15 kw.

* * * *

type letters from a storage magazine are set up in front of the pot by means of an intricate mechanism, operated from a keyboard similar to a typewriter keyboard. When they are in position, the pot is tipped forward against the mold containing these type letters. A plunger inside then forces molten metal out through orifices in the front of the pot and into the mold, the operation resulting in a thin strip of metal with the letters molded on one edge. This operation is repeated for each line.

The thermostat is shown mounted on top of the pot. The sensitive element extends downward through a slot in the cover and into the molten metal. The heating units of these particular pots are applied outside the crucible rather than inside, as this permits a better use of the space.

After the type has been used it is remelted in a larger pot, similar to the one shown in Fig. 9, from which it is cast into pigs and is again ready for use in the typesetting machines.

One of the most important uses of immersion units is in the large stereotype pots from which the type-bearing cylinders for the printing press rolls are cast. These pots hold from 1 to 8 tons or more of metal, depending on the size of the paper, and when the paper is about to go to press a large number of cylinders must be cast in a short period of time.

* * * *

FIG. 12 — HIGH-TEMPERATURE pots for babbitting bearings in a railway shop. The operating temperature of these pots is 1,100 deg. F. The preheating oven can be seen at the back.

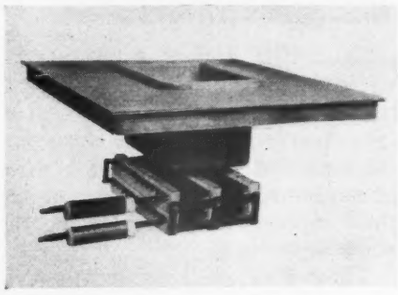


FIG. 11—THE EXTERNAL HEATING UNITS used with high-temperature babbitt melting pots.

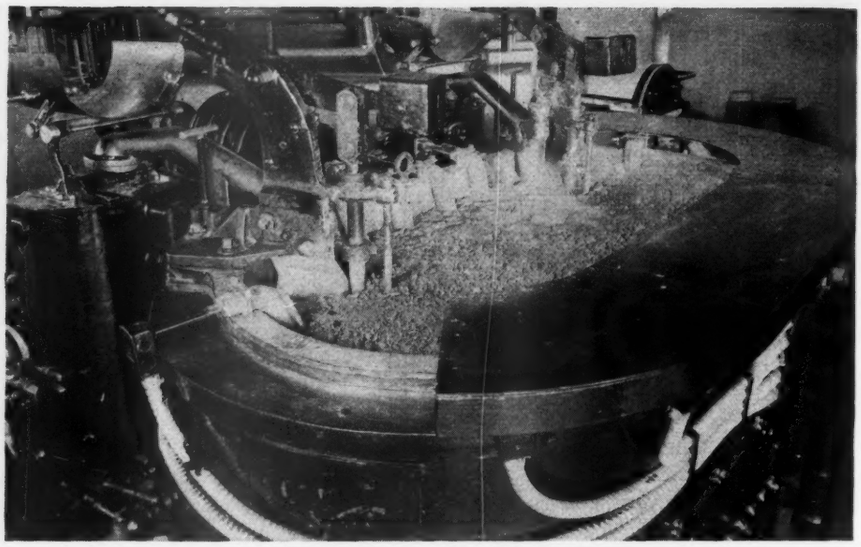


FIG. 10—CLOSE-UP VIEW of stereotype metal pot. Twelve immersion heating units of 5-kw. rating each are used in this pot, which has a capacity of 6 tons.

* * * *

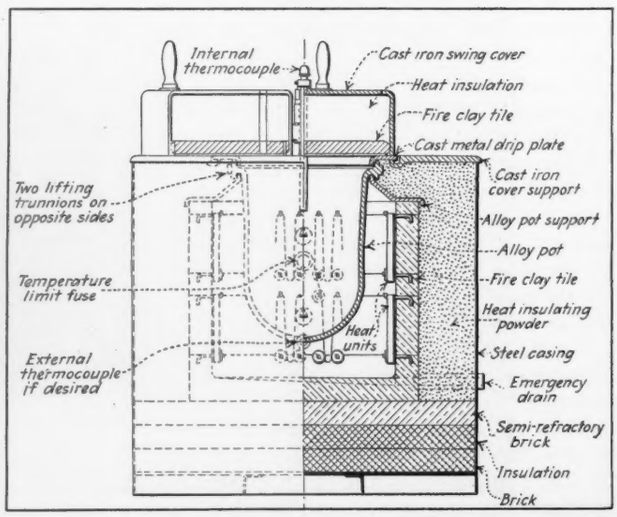
Fig. 10 represents a close-up view of a typical pot, showing the heating units in position. The molten metal is removed from the pot by means of pumps, which are clearly shown in the photograph.

These pots are usually maintained at full temperature constantly, in order to produce the frequent editions which some papers publish, or to take care of extra editions in case the necessity should arise.

(Please turn to page 188)

* * * *

FIG. 13—CROSS-SECTION of lead bath for heat-treating steel. Pots of this type are used extensively by the manufacturers of small tools, such as drills, reamers, taps, etc.



Layout and Winding *of Pulled Coils*

By A. C. ROE
Renewal Parts Engineering Dept., Westinghouse Electric & Manufacturing Company,
and
D. H. BRAYMER

IN A PREVIOUS article in the January issue of INDUSTRIAL ENGINEERING, the principles and methods involved in making pulled coils were discussed at some length. Further details of the procedure necessitated by the type of coil to be wound, will be given in this article.

There are two ways of making coils and each method is classified according to the location of the top cell or slot section of the coil. These classifications are, (1) right-hand coils and (2) left-hand coils.

Figs. 1 and 2 show a "left-hand coil," the "hand" being determined by the side on which the top cell is placed with the observer facing the lead end of the coil. Notice that in Figs. 1 and 2 the top cell is on the left, hence the term left-hand coil.

In Figs. 3 and 4 a "right-hand" coil is shown, the top cell being on the right-hand side when facing the lead end of the coil.

The "hand" of the coil has some effect on the pulling operations, and in winding d.c. wave-wound armatures. On some of the older, two-phase machines, one-half of the coils were made right and the other half of the set left hand. This put the leads and connections of each phase on opposite sides of the winding. The same practice is followed in modern two-winding jobs, one set of coils being left hand and the other set right hand, thus putting the connections of each winding on opposite sides and avoiding the chances of mixing the connections of both windings, and causing trouble.

The left-hand coil is the one most used in winding the coil on the shuttle. The wire is started on the right-hand side of the shuttle, which is always the removable piece of the mold. This allows the coil to be easily removed from the shuttle. Also, when pulling the coils and tying the leads while the coil is held in the puller jaws, the operator can work to better advantage.

When winding a d.c. armature with left-hand coils that are connected up as a wave winding, the winder can put the armature in a stand with the commutator on the right-hand side when facing the armature. Then the winder can put in the left-hand coils with the top half of the coil away from him. Pushing the top half away from him, allows him to put down the bottom leads of each coil without having to walk out and around to the front of the armature.

With a right-hand coil, the commutator must be placed on the left, with the winder facing the armature. When the top half of the coil is pushed away from him, he will be forced to step out in front of the commutator to put the bottom leads down; this is due to the necessity of using his right hand. With the commutator on the left, he would have to twist his body to an unworkable position in order to put the leads down without moving out in front.

There is no benefit to be derived from either a right- or left-hand coil if the winder pulls the top half of the coil towards him and winds with the commutator on the left for right-hand coils, or with the commutator on the right for left-hand coils.

Bringing Out Leads.—There are four distinct ways of bringing out the leads of pulled coils that are wound straight up. The term "straight up" will be explained later.

(1) Leads are brought out at the end of the straight parts, as at *A* in Figs. 1 to 4.

(2) Leads are brought out at the diamond points, as at *B* in Figs. 1 to 4. In all of these diagrams a shaded line indicates which side of the coil the lead at the diamond point comes from.

It will be noted that with left-hand coils and the leads at the diamond point, and on top, the starting or bottom lead is brought out to the right-hand side of the diamond point in pulling (see Fig. 1), and also that for right-hand coils with leads on top, the starting or bottom lead is brought out to the left of the diamond point (see Fig. 3).

With the leads on the bottom at the diamond point, the starting or top lead is brought out to the left of the diamond point for left-hand coils (see Fig. 2) and to the right of the diamond point for right-hand coils (see Fig. 4).

(3) This is the condition when the leads are brought out on top, as in Figs. 1 and 3. By "on top" is meant the top of the coil when placed in a rotor or the part of the coil farthest away from the center of the bore or diameter. The reason for considering the top the same for rotor or stator coils, when talking about leads, is that stator coils are pulled in the same position as rotor coils, but when winding the coils in the machine or stator, the stator coils are, of course, inverted.

(4) This is the condition when the leads are brought out on the bottom, as in Figs. 2 and 4.

From the above rules, a rotor or stator coil can be called for with the leads on top, at the ends of the straight part, left hand, and both be wound and pulled the same except for the location of the long cell, as will be explained later on in this article.

The method of starting straight-up shuttle coils will next be explained. The term "straight up," as applied to puller coils, means that the turns are built up from the center blocks in layers, as at *D* in Fig. 5, which shows a two-turn coil, two wires in parallel, each turn consisting of one layer two wires wide. In this case a turn also adds a layer. At *E* is shown a four-turn, two-layer coil, the first turn starting at the left. The second turn in the first layer is to the right. The third turn is put on top of the second turn and starts the second layer. This is called the crossover or change from

one layer to the next. The fourth turn is to the left of the third turn and ends the second layer. Thus in a straight-up winding the layers are built up a turn at a time, the number of turns per layer depending on the formation of the coil; that is, the number of wires deep by wires wide, and the number of wires in parallel per turn.

When there is more than one turn per layer, the crossover should be carefully made and in some cases extra insulation must be added. The subject of crossovers will be dealt with in an article that will appear in a succeeding issue.

Fig. 5 shows the way to start all right-hand shuttle coils. The starting lead or wire is fastened on the left-hand side of the shuttle, with the winder standing at *X* and facing the machine. In this diagram figure *B* shows how the wound coil would appear looking in the direction of the arrow, the shuttle being turned in a clockwise direction, when facing the machine, as indicated by arrow *B*. Note that the starting lead is on the far side of the turns around the front loop.

Fig. 6 shows how a left-hand shuttle coil is started. The starting lead or wire is fastened on the right-hand side of the shuttle. Note that the starting lead is on the near side of the front loop.

From the above it is evident that the following rules apply to starting straight-up shuttle coils:

(1) For left-hand coils start on the *RIGHT*.

(2) For right-hand coils start on the *LEFT*.

After the coils are wound there are certain rules that must be followed in placing the coils in the pulling machine or spreading fixture used.

As a general rule all puller coils have the length of the straight part of the top cell or slot section longer than the bottom cell. This is done to allow for spreading or flaring of the coil, and also to provide better insulation between the top and bottom layers of the coil ends where they leave the slots.

The top or long cell is placed nearest the air gap for a rotor or stator

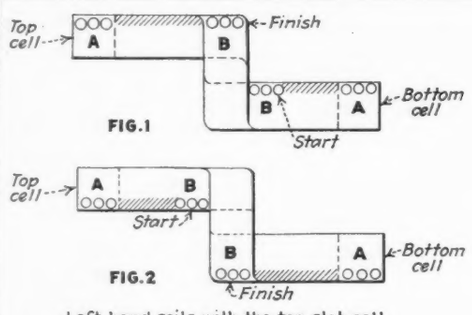


FIG.1

FIG.2

Left-hand coils with the top slot cell on the left

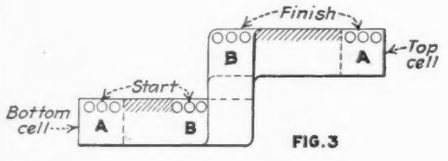


FIG.3

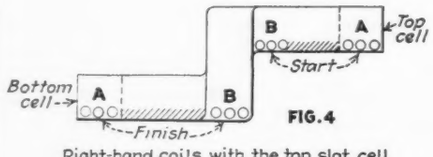


FIG.4

Right-hand coils with the top slot cell on the right

FIG.7-A left-hand rotor coil with the long cell on top at the left. If this drawing is turned upside down it will represent a left-hand **stator** coil. The coil will be below the bore of the stator line **X-Y**, with the long cell on the bottom, as at **T**, and the short cell on top

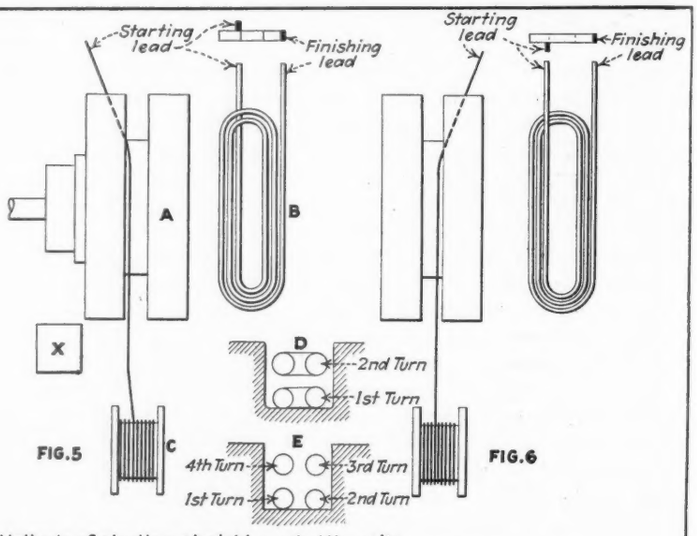


FIG.5 FIG.6

Methods of starting straight-up shuttle coils
In **FIG.5** a two-turn, right-hand coil is shown, two wires in parallel.
In **FIG.6** the left-hand shuttle coil is shown with the starting lead or wire on the right

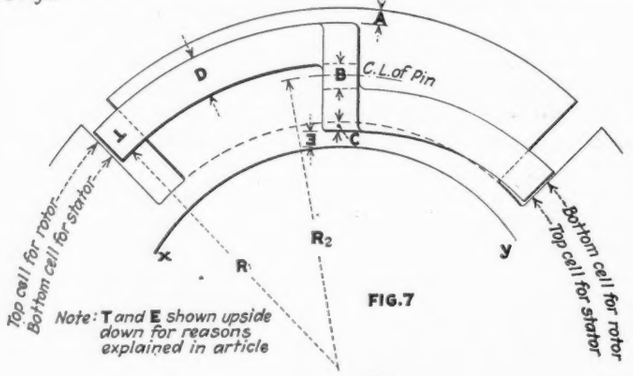


FIG.7

Note: **T** and **E** shown upside down for reasons explained in article

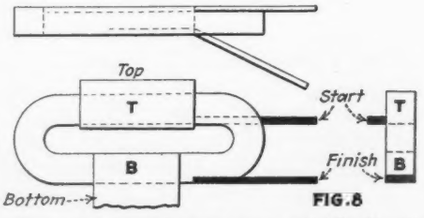
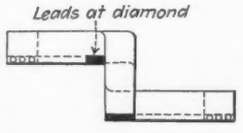


FIG.8



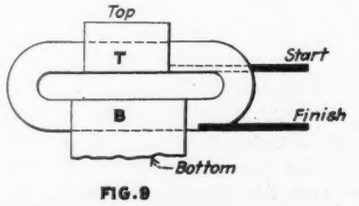
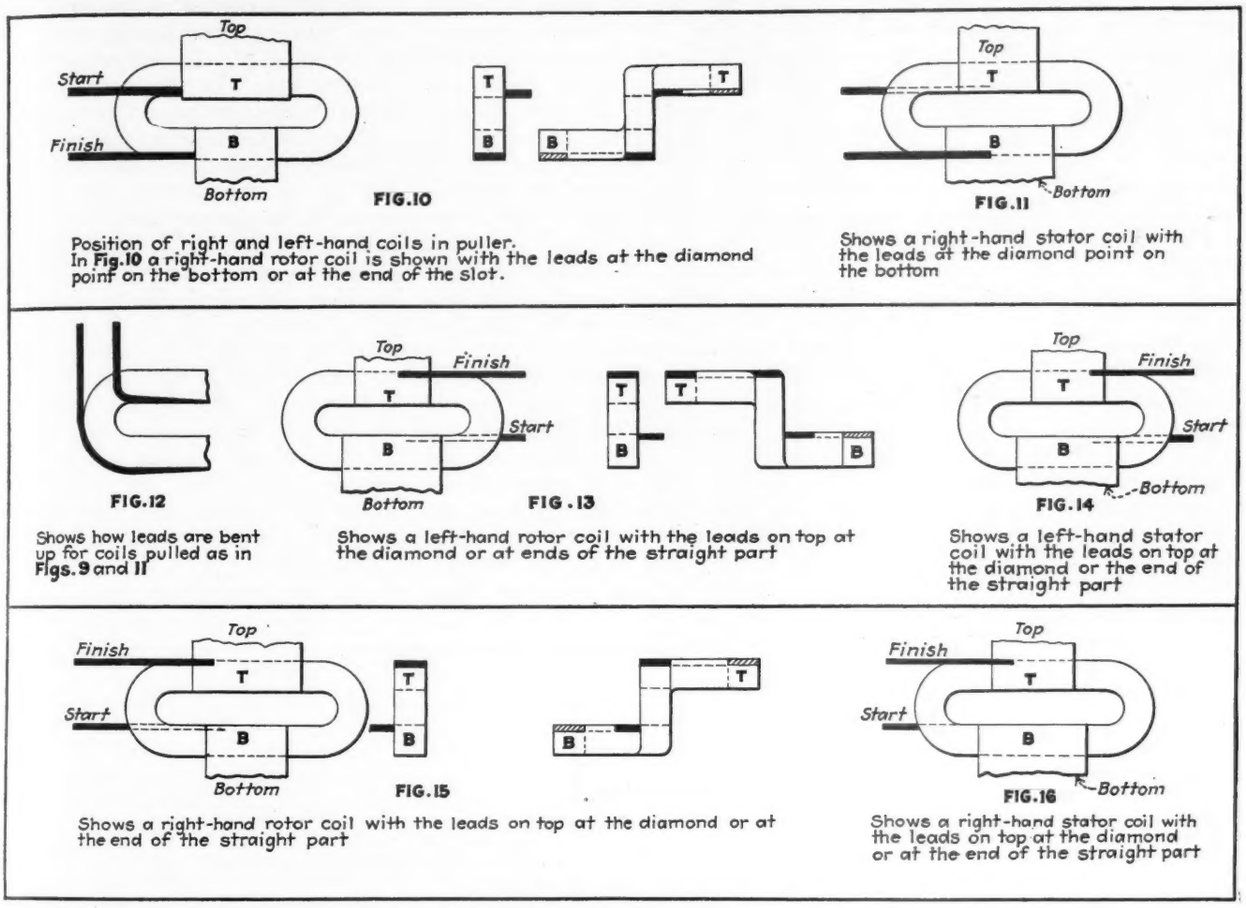


FIG.9

Position in puller for left-hand rotor coil (**fig.8**) with leads on bottom at end of straight part or at diamond point. **FIG.9** shows a left-hand stator coil with leads on bottom at diamond point


Top
Start
Finish
T
B
Bottom
FIG.10
Position of right and left-hand coils in puller. In Fig.10 a right-hand rotor coil is shown with the leads at the diamond point on the bottom or at the end of the slot.
FIG.11
Shows a right-hand stator coil with the leads at the diamond point on the bottom
FIG.12
Shows how leads are bent up for coils pulled as in Figs. 9 and 11
FIG.13
Shows a left-hand rotor coil with the leads on top at the diamond or at ends of the straight part
FIG.14
Shows a left-hand stator coil with the leads on top at the diamond or the end of the straight part
FIG.15
Shows a right-hand rotor coil with the leads on top at the diamond or at the end of the straight part
FIG.16
Shows a right-hand stator coil with the leads on top at the diamond or at the end of the straight part

coil, and when used as a rotor coil is wound on the outside diameter (see Fig. 7) whereas a stator coil is wound on the inside diameter. By turning Fig. 7 up side down and calling line XY the stator bore, it follows that a stator coil can be pulled as a rotor coil and inverted and used as a stator coil, there being two major points of difference.

The first is the location of the long cell iron in the pulling machine. These points can be explained by using Fig. 7 which in normal position shows a left-hand rotor coil with the long or top cell on top at the left. By turning Fig. 7 around so that the top of the drawing is at the bottom, we have a left-hand stator coil. The radius on the coil ends being correct and the coil being below the bore of the stator line XY, the long cell will now be on the bottom as at T and the short cell on top, which brings us to the following rules regarding long cells:

(1) The long cell for rotor coils must be on the top or movable arm of the pulling machine.

(2) The long cell for stator coils must be on the bottom or fixed arm of the pulling machine.

The other point is the clearance between the coil and the iron, as at A and E, Fig. 7. For a rotor the distance A is increased by decreasing R_2 or pulling the diamond point down, but for a stator coil the distance E must be increased by increasing R_2, which brings out another rule: To obtain clearance between the top of the coil diamond point and the iron for a rotor, the diamond point must be pulled or kicked down, whereas for a stator the diamond point must be pulled or kicked up.

The next point to consider will be the method of placing the shuttle coil in the pulling machine to get the leads and cells and the hand correct.

(1) For a left-hand rotor coil with leads on the bottom at the end of the straight part or at the diamond point, place the coil as in Fig. 8, with the leads on the right and the starting lead up, in the movable arm, the long cell being on movable arm.

(2) For a left-hand stator coil with the leads on the bottom at the diamond point, see Fig. 9. This is the same as Fig. 8 except that the long cell is placed on the fixed arm.

(3) For a right-hand rotor coil with leads on the bottom at the diamond point or at the ends of the straight part. Fig. 17 shows the leads at the ends of the straight parts on top. Place shuttle coil with the leads on the left as in Fig. 10, with the long cell on the movable arm and the starting lead up.

(4) For a right-hand stator coil with the leads on the bottom at the diamond point see Fig. 11 which is same as Fig. 10 except that the long cell is on the fixed arm.

Note that as a general rule stator coils are pulled with the leads on top, but when pulled with the leads on the bottom, the leads are bent up, as shown in Fig. 12. This is done when the room between the coil ends and end shields or brackets is close or scant, as this method allows all stub and other connections to be bent back out of the way.

(5) For left-hand rotor coils with the leads on top at the diamond point or at the ends of the straight part, also with the leads on the right and the starting lead down in the fixed arm, the long cell being on the movable arm, see Fig. 13. Fig. 19 shows a left-hand rotor coil with the leads on top at the end of the straight part.

(6) For left-hand stator coils with the leads on top at the diamond point, see Fig. 14, which is the same as Fig. 13 except that the long cell is on the movable arm.

(7) For right-hand rotor coils with the leads on top at the diamond

points or at the ends of the straight parts, see Fig. 15. The leads are at the left with the starting lead on the fixed arm and on the far side of the loop, the long cell being on the movable arm.

(8) For right-hand stator coils with the leads on top at the diamond points, see Fig. 16, which is same as Fig. 15 except that the long cells are on the fixed arm. Note that leads on top at the diamond points are standard for all stator coils, see Figs. 14 or 16, for motors of low and medium voltages, when the straight short stub or bent U-stub connection is used.

For wound rotors used in induction motors, leads on the bottom at the diamond points are standard as in Figs. 8 and 10.

Particular note should be taken of the position of the starting and finishing leads in all diagrams and also the side of the loop on which the starting lead lies. For example: consider Figs. 8, 9, 10, and 11, which show the leads on the bottom for right- and left-hand coils in all these figures. Note that the starting lead is on the near side of the loop; by near side is meant the side facing the operator when pulling the coils. Then, consider Figs. 13, 14, 15, and 16, which are for stator and rotor coils, right and left hand, with the leads on top. The starting lead is on the fixed jaw and on the far side of the loop.

We can then give two rules as follows: (1) When the leads are on top on right- and left-hand coils, the starting lead is in the fixed jaw and on the far side, when being pulled.

(2) When the leads are on the bottom on right- and left-hand coils, the starting lead is on the movable jaw and on the near side when being pulled.

Fig. 19 furnishes an example of what happens when the above rules are not followed. The coil shown is a left-hand coil with the leads on top and at the ends of the straight part.

From the above rules this type of coil should be started on the left while winding on the shuttle, and when pulling it, the starting leads should be in the fixed jaw and to the far side. Through an error, the coil in Fig. 19 had been started on the left and to get a left-hand coil the leads were placed on the right for pulling, with the starting lead in the fixed jaw for leads on top. Due to the error in winding the starting lead had to be put on the near side as shown, for pulling. Then when the coil was pulled, the starting lead was on the left-hand side of the diamond point, as at *A*, and to get the lead out at the end of the straight part, as indicated

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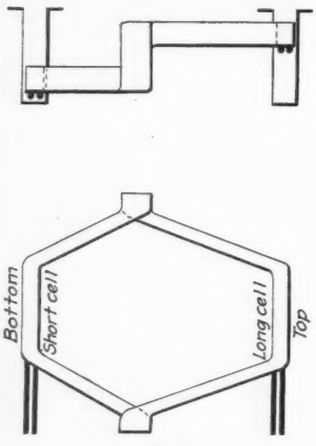


FIG.17

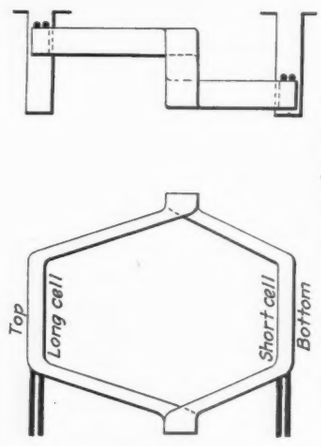


FIG.18

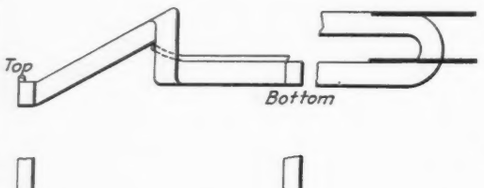
WINDING AND PULLING RULES FOR SHUTTLE PULLER COILS

Hand of Coil	Type	Leads				Long or Top Cell
		At Diamond or Ends of Straight Parts				
		On Top	On Bottom	Lead Position While		
				Winding	Pulling	
Right-hand	Rotor	Fig.15	Fig.10	On left Fig.5	On left	On movable arm
Left-hand	Rotor	Fig.13	Fig.8	On right Fig.6	On right	
Right-hand	Stator	Fig.16*	Fig.11	On left. Fig.5	On left	On fixed arm
Left-hand	Stator	Fig.14*	Fig.9	On right. Fig.6	On right	

*Equal standard for low and medium voltages

FIG.17 and **18**-Pulled right-hand coil **(Fig.17)** with the leads on the bottom and the long cell on top for a rotor

FIG.18 shows a left-hand rotor coil with the leads and the long cell on top



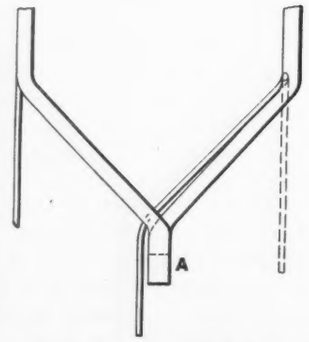
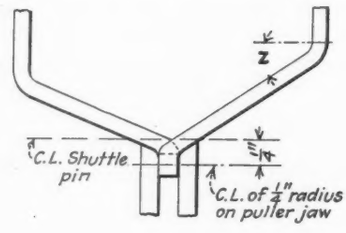


FIG.19

Shows a left-hand coil end with the leads on the top on the right, but started on the left while winding. The bottom lead must be pulled through to the dotted line



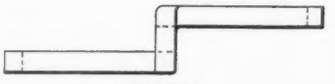


FIG.20

Shows a straight up and down diamond point short bend

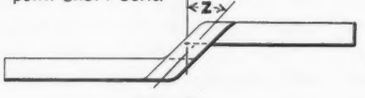


FIG.22

Represents an oblique diamond point with short bends

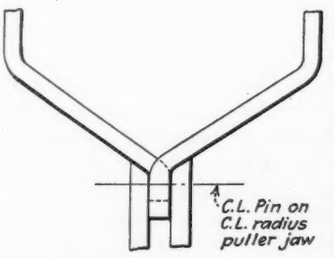


FIG.21

A straight up and down diamond point, long bend is shown

FIGS. 19 TO 22

Coil ends for various conditions

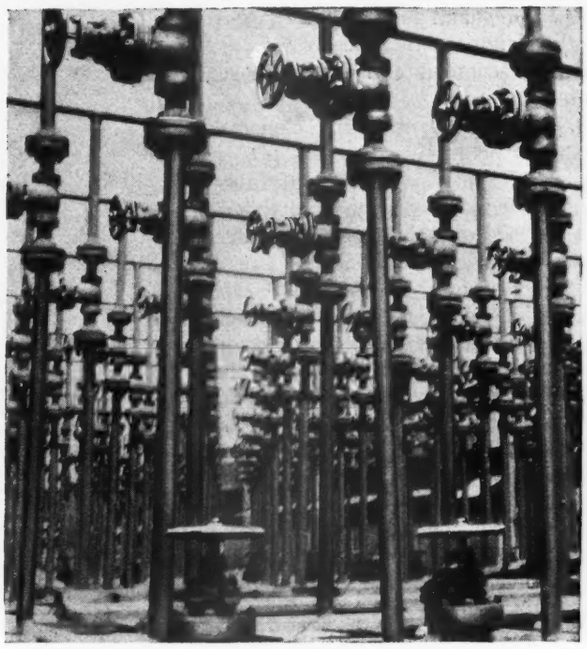
Features that distinguish

Low Maintenance PIPE, VALVES and FITTINGS

Explained

By JOHN J. HARMAN

Research Engineer
Walworth Co., Boston, Mass.



This equipment for pumping oil wells by compressed air presents a real problem in maintenance

ONE of the very important aids to human effort that has contributed largely to the progress of civilization is the conveying of fluids by pipe lines, so that they can be distributed to the various points where they are needed, in the quantities and at the pressures required.

Pipe, with its connecting fittings, supplies the conduits for conveying and distributing fluids, and valves provide the medium for controlling and regulating their flow. So great a quantity of piping, valves, and fittings is required each year, both for new construction and for replacements, that the manufacture of these items ranks as one of our major industries.

Vast pipe line systems carry oil from the producing fields over mountains, under rivers, and across plains to centralized oil refineries and thence to seaports for ocean shipment. Gas is similarly taken to the centers of industry where it is utilized. Again many large cities secure their supply of pure water in remote places far from the centers of population, bringing it in by pipe line over long distances and distributing it through pipes to every public and business building, industrial plant, and private residence. It is also found economical, in many cases, to carry high pressure steam over relatively long distances in spite of the unavoidable loss of pressure and heat.

Every steam power plant contains a network of piping, and industrial processes of every description depend upon piping for their operation; in fact hardly anything is built in this modern age which does not contain its own individual piping system.

This extensive use of piping for conveying steam, water, oil, gas, air, chemicals, and so on, at pressures ranging from less than atmospheric to thousands of pounds per square inch naturally requires a number of different kinds of piping. Cast iron, steel, copper-bearing steel, wrought iron, galvanized, brass (of various compositions), copper, lead, lead-lined, stainless steel, high-silicon iron, wood, hard rubber, and other forms of pipe are all used in commercial practice. Ungalvanized steel pipe is, however, by far the most universally used, the economical use of other types of piping being limited to specific applications where the life of, and service rendered by, steel pipe is not satisfactory due to the corrosion conditions experienced.

Corrosion an Important Cause of Waste

Corrosion of metals is one of the most important causes of waste with which the world has to contend, and technical study of the problem has been increasing from year to year. A notable experiment that is now being carried on in this country is the soil corrosion test that was started in 1922 by the Bureau of Standards in co-operation with a number of other interests. Several progress reports have been made on this test, but final conclusions will not be reached for some years.

Ores, as found in the earth, consist of metals in chemical combination with other elements. When these metals are purified and refined by man the forces of nature conspire to cause them to revert to their original state of impurity. This progressive degradation proceeds more or less actively all the time and the life of the metal in its useful form depends, first, upon the nature and potency of the many degrading forces that may be acting under various conditions and, second, upon the ability of the metal to resist these forces.

Corrosion of pipe lines is resisted in a number of different ways in commercial practice, such as by:

1. Providing excess metal thickness to compensate for loss by corrosion.
2. Using metallic, corrosion-resistant coatings to protect the base metal.
3. Using special metals or alloys that are highly resistant to corrosion under the particular service conditions in question.
4. Chemical treatment of the fluid carried to reduce corrosion.

Each of these processes involves a substantial increase in the primary installation cost of equipment and can be justified on an economic basis only by substantial savings in maintenance cost. The true cost of a pipe line system is made up not only of the primary installation cost, but also includes additional charges extending over a period of years. due to:

1. Interest and depreciation charges on the original investment.

2. Replacements and expense incidental thereto.

3. Expense of operating chemical treatment plant, if used.

4. Inefficient performance of functions for which pipe line is intended, due to inadequate design, unsuitable materials or other causes.

On account of our lack of exact knowledge as to the rate at which corrosion of the various materials in commercial use will proceed under the almost infinite variety of corrosive conditions that occur in practice, it is not always possible to calculate with scientific accuracy the most economical material to use. For this reason we find considerable lack of uniformity in practice in some lines of work; in others standardization of materials, design, and dimensions is well advanced.

Standardization is closely tied up with the economics of pipe line design and construction because it makes mass production possible and stabilizes production and employment by permitting the manufacturer to accumulate stocks, during dull times, with safety. It simplifies the carrying of stocks, makes deliveries quicker, and prices lower.

During the past several years various sponsor organizations operating under the procedure of the American Engineering Standards Committee have been working on American Standards covering, among other items, welded and seamless steel pipe and malleable and cast-iron fittings for various steam pressures.

A very important development in the standardization of pipe, valves, and fittings, is a National Piping Code for all kinds of service above 25 lb. working pressure, which is now being formulated by a special committee of the American Engineering Standards Committee.

* * * *

PROPER INSTALLATION and maintenance speak for themselves. This is a typical design of engine room header and engine leads.

THIS 8-IN., high-pressure steam line is a mile long.

* * * *

Modern Steam Plant Practice

Modern steam plant practice is trending rapidly toward the use of higher steam pressures and temperatures and many new problems have been introduced by the rapid changes in service requirements. Whereas 250 lb. was considered a high pressure a few years ago, 400 to 500 lb. pressure has now become quite common and a number of plants, both in this country and abroad, have gone to much higher pressures.

In American steam plant practice 750 deg. F. total temperature has so far been considered the upper limit, but in the oil industry temperatures of 900 to 1,000 deg. F. are not uncommon. Due to the fact that most materials in commercial use today begin to fall off in strength and hardness rather rapidly at these temperatures, the problem of combining the proper materials, design, and workmanship so as to withstand successfully these service conditions is not an easy one to solve. Recent practice is trending entirely away from the use of cast-iron fittings and valves for superheated steam, and the upper limit of working temperature for cast iron, when used for fluids other than steam, is in most instances being held down to 450 deg. F.

Malleable-iron fittings are also usually limited to 450 deg. F. maximum temperature, although in the oil industry they are being successfully used at much higher temperatures. High-grade bronze valves may be used for temperatures up to 550 deg. F.; for temperatures above this steel valves and fittings should be em-

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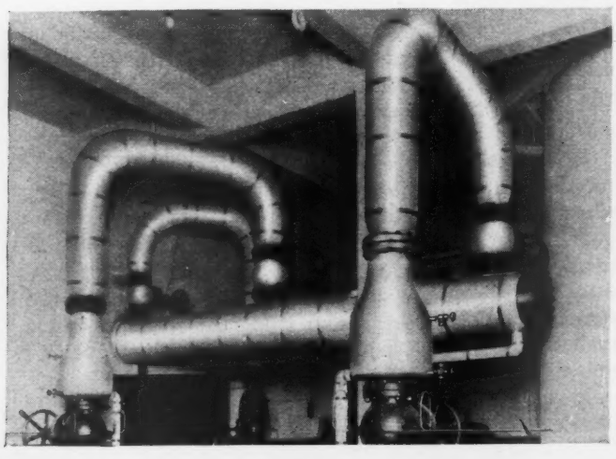
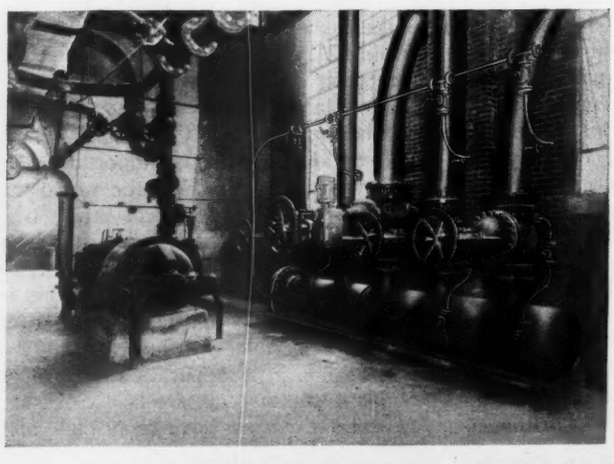
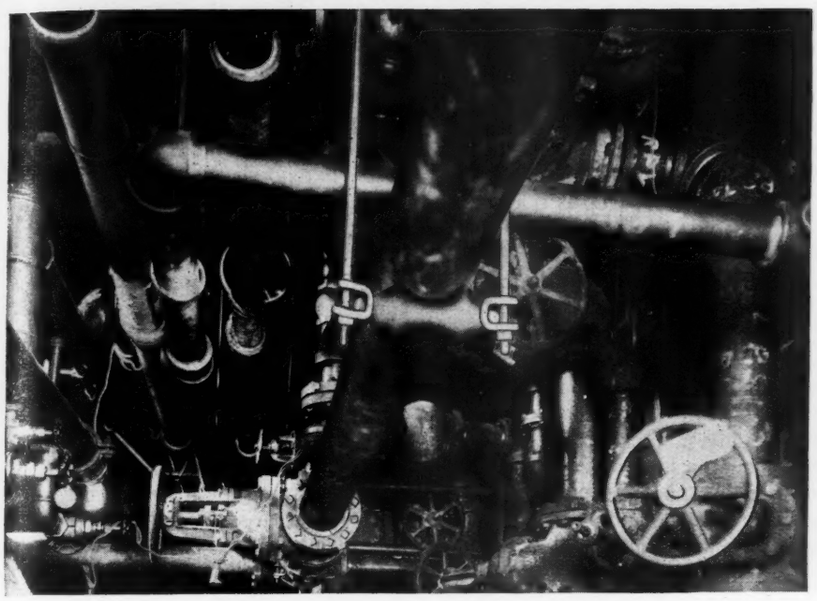
THE GATE VALVES in this header operate under a pressure of 400 lb. per sq.in. The large valve in the center is operated by a motor.







One of the piping tunnels at Harvard University.

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ployed. Due to special conditions, steel valves and fittings are often used at temperatures below 550 deg. F.

Minor defects in materials become of increasing importance at elevated temperatures and pressures, and much study and care in manufacture are required to provide the necessary factor of safety. An interesting development in this connection is the detection of defects in steel castings by the use of the X-ray, the study of their nature and causes, and the perfecting of foundry technique so as to eliminate the causes of these defects. Great improvement in steel castings has been made in this way.

Careful control of working tolerances in machining the mating surfaces of valves, high-grade workmanship, and painstaking inspection and tests are also necessary in order to meet the requirements of these extremely severe service conditions.

The question of the proper trim materials for high-temperature valves has been given much study and is now in process of solution by laboratory research and service tests. At temperatures above 500 to 550 deg. F. bronze is not suitable for use as a trim material; the materials most commonly used at present are nickel-copper alloys or some form of corrosion-resistant steel.

The need for motor-operated valves and for bypasses is more acute in high-pressure service and they are being more extensively used. In high-temperature service on both water and steam, threaded joints on pipe above 2 in. in size have been found unsatisfactory for pressures above 250 lb. per sq.in. and it is customary to use the Van Stone type of joint, or some modification of it.

Alloy-steel studs, with nuts on both ends, conforming to the latest revision of A.S.T.M. Specification A-96, Class C, and having a tensile strength above 125,000 lb. per sq.in., and with a yield point above 105,000 lb. per sq.in., are used for high-temperature flanged joints both on pipe end and valve bonnet flanges. The type of construction used for high-pressure, high-temperature valves is well illustrated by the sectional outline drawing at the bottom of the page, of a modern, cast-steel gate valve rated at 400 lb. w.s.p. at 750 deg. F. This valve, although not new in general type, has "thirty points of merit" in its design, materials and construction, and typifies the advances and refinements made during recent years in valve construction.

The selection of the proper valve for a specific location or service is sometimes a troublesome problem and it may not be amiss to point out some of the factors that should be considered.

In general, gate valves are to be preferred on both steam and water lines because when fully opened they afford an unrestricted, straight-way passage for the fluid, so that the pressure drop through the valve is very slight. This feature is particularly advantageous where velocities are high, or sediment passes through the valve.

The pressure drop through a globe valve on water service is from 15 to 40 times as great as it is in a gate valve. On steam service the pressure drop is usually not so great as it is with water because the mass or weight of the fluid passing through the valve in a given times is less. The loss is, however, much greater than it is in a gate valve, and in some cases is quite objectionable.

Another advantage of the gate valve over the globe valve is that it is self-draining, whereas a globe valve diaphragm forms a pocket which can be drained only by a bleeder connection. Water held in this way may cause damage by freezing or through the accumulation of sediment, or, in the case of a steam line, by causing water hammer.

Gate valves are not so well adapted as globe valves for use in throttling or regulating flow. If valves must be opened and closed frequently a globe valve should be used in preference to a gate valve, because less turns of the handwheel are required to open

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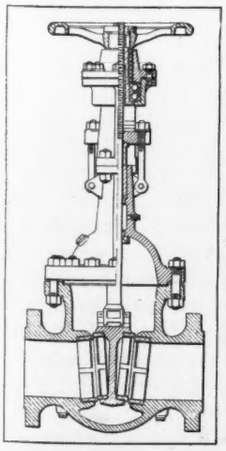
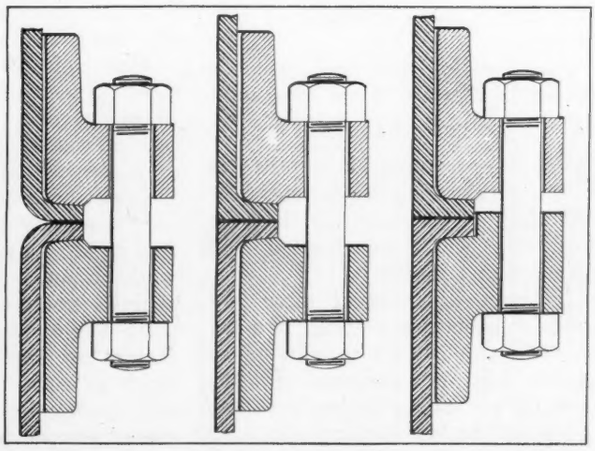
DETAILS of a modern steel gate valve. This valve has been designed for a working steam pressure of 400 lb. per sq.in. and operates at a temperature of about 750 deg. F.



THREE different types of the Van Stone joint. The round corner joint is shown at the left. The center and right views show the square corner male and female types, respectively



it fully. This reduces the time and effort required for operating the valve, and also reduces the wear on the stem threads. As service of this character is unusually severe a regrinding or renewable seat and disk type of globe valve should preferably be used.

Stem threads of ample proportion having a long engagement in the bonnet when the valve is fully closed are also desirable. In service of this kind two valves are often placed in the line in tandem. In operation, No. 1 valve is always opened before No. 2 is opened, and closed after No. 2 is closed, thus protecting the seats of No. 1 valve from the erosive effect of wire drawing.

If ample provision for expansion, and other considerations, will permit the use of a properly-designed angle valve in place of a globe valve, a nipple, and an elbow, considerable pressure drop will be saved, as well as extra pipe fittings and miscellaneous joints.

When pressure drop is not an important factor, globe valves are often used in preference to the gate type, particularly in the smaller sizes, because they are less expensive.

Having determined the general type of valve to use in each individual location, the selection of the materials from which the valves should be made is generally a question of suitability and economics. In some cases the question of appearance is also an important factor, and highly-polished brass or nickel-plated valves may be used. The more recently developed chromium-plated product is also entering this field.

It may safely be stated that in pipe line construction today more attention is being given than ever before to costs extending over a period of years, and including maintenance and replacements as well as the initial investment. Our knowledge of corrosion conditions in service and the corrosion- and heat-resisting properties of metals is increasing, which tends to make more accurate cost estimates possible. However, much still remains to be done along these lines. The prospect of further improvement still promises rewards worthy of all the time, effort, and money that are being spent to make low maintenance pipe, valves, and fittings a reality.

Electrically Heated Melting Pots

(Continued from Page 180)

The number of units required depends, of course, on the size of the pot and the quantity of metal to be melted. The pot shown in Fig. 10 has a holding capacity of 6 tons of metal, and is equipped with twelve units, rated at 5 kw. each, or 60 kw. total.

The cost of heating with electricity as compared to gas, will depend on the rates obtainable in a given locality. The cost is equal with city gas at $1.00 per 1,000 cu.ft. and electricity at $1\frac{3}{4}$ cents per kilowatt-hour.

Units of this type can also be applied to the electrotype pots, used in making the plates for the pictures and some advertising sections of newspapers. These pots are usually shallow. The electrical equipment for each pot consists of six units rated at 5 kw. each, or 30 kw. total, with automatic control, and consumes an average of 287 kw.-hr. per day.

The temperature variation when working is from 620 to 650 deg. F., a maximum of 30 deg. When heavy charges of pigged metal are added the drop is about 50 deg., but the pot is ready for operation again in 15 min.

Uniform temperature control and quick recovery after replenishing the metal are important considerations to the electrotyper. Electrically-heated pots using immersion units meet his requirements well, at a reasonable cost, and in addition provide working conditions that are a new experience for him.

Summing up, the advantages of immersion units in any suitable application are:

(1) Heat is generated within the metal itself, eliminating high external temperatures and possibility of cracking the pot.

(2) The construction of the equipment can be simplified and, therefore, reduced in cost.

(3) Temperature control is better than with external firing, due to elimination of heat storage in the brickwork.

(4) The over-all dimensions can be reduced.

(5) Any desired heat distribution can be obtained in long pots by moving the units.

(6) Replacement of heating units can readily be made, usually while the pot is in operation.

(7) More comfortable working conditions due to absence of noise, excessive heat, or products of combustion.

(8) Existing fuel-fired pots can readily be changed to use these units.

High-Temperature Pots

For temperatures above 950 deg. F. it is necessary to use external heating units. Such a pot is shown in Fig. 11, with the heating unit mounted underneath.

A group of three of these pots, used for babbitting bearings in a railway shop, is shown in Fig. 12 together with an electrically-heated oven for preheating the bearing shells.

For still higher temperatures, 1,500 to 1,600 deg. F. such as are required in lead and cyanide baths for heat-treating and case-hardening steel pots of round or rectangular shape, having cast nickel-chromium crucibles are used.

Electrically-heated pots of this type are being used extensively by manufacturers of small tools, such as drills, reamers, taps, axes, hammers, and so on. The advantages secured are a more uniform product, due to better temperature control, much longer life and lower maintenance cost, better working conditions, and in most cases an equal or lower heating cost than obtainable with fuel firing. A cross-section of a typical pot is shown in Fig. 13.

Electric heat is finding a rapidly broadening field of usefulness in many industries, and the extent of its use today is little short of amazing when compared to the beginnings of a few years ago.

Heat unit for heat unit, it is the most expensive fuel available, and yet in many cases it yields the lowest over-all cost or equivalent advantages, as evidenced by its extensive use in the most progressive industries.

It is an easy matter to measure the fuel input to a furnace and weigh the work output, but this is a superficial analysis and does not tell the whole truth. A careful analysis of all the factors involved is the only way to reach a sound conclusion, and this will usually be found to favor the use of electric heat.

P. T. VAN BIBBER *describes a positive*

Box-Counting Device for Gravity Conveyors

that will tally the day's run without further checking

ALTHOUGH, accurate and positive counting of boxes and cartons in a continuous, unbroken line on gravity conveyors is not by any means new it is, apparently, unknown, even by some of the manufacturers of conveying equipment. The device outlined here, was first tried out successfully in mechanical form not more than two years ago in a well-known bottling plant in the East. Its originator in this place had already made use of the idea several years before in a Western plant. The electrical recording feature is a later development of the writer's in connection with the use of well-known, magnetically-operated counters for remote control service.

Referring to sketch in Fig. 1, the fundamental principle of the mechanical feature of the counting mechanism is almost self-explanatory. A point is selected where the speed of the moving boxes is not very great, as at the discharge of an elevator, or "booster" as it is commonly called in conveyor language. Not more than 10 ft. beyond the elevator, the gravity-conveyor line is broken and lowered, so that there is a drop of about 1 in. or less between the last roller of the conveyor section next to booster, and the first roller of next section.

A contact wheel about the diameter of the rollers, supported on a vertical arm through a slotted plate and attached to the counting device below (whether it is the mechanical or the electrical type), normally projects to the level of the rollers of first section. When a box passes over the drop in levels of the two sections, this small wheel is depressed by the amount of drop distance each time the rear end of a box leaves the upper roller and falls to the lower level. The wheel is again released when the end of the box passes by it, since the succeeding box has its front end at the upper level until its center of gravity passes the last upper level roller.

It is obvious that the difference in levels must not be so great that the front end of box will catch on a roller when it pitches down. Although, the sketch in Fig. 1 show a contact switch being operated by the depression of the wheel, this same arrangement was used to operate a mechanical counter when first observed. The counting was reliable enough to be accepted at the end of each day as the actual day's run without further checking up. The counting section of the conveyor was enclosed by a sheet-metal tunnel to prevent tampering, whereas, the counter was locked up in a small box underneath.

The additional device shown in Fig. 2 is wholly for electrically-operated counters at a remote point from the conveyor, usually in some office. This particular arrangement was designed to separately count three different sizes of packages that were traveling along the conveyor to the shipping platform. Advantage was taken of the three different heights; but to carry the idea further, use was made of different widths also, on the same conveyor line.

The electric control is effected by the use of a standard-type, double, push-button switch as employed on remote control of large motors. Each button not only closes a separate cir-

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FIG. 1—TAKING THE COUNT from the higher to the lower level. An electrical counter operated by the depression of the fiber wheel. The roller is partly cut away to show the mounting of the counting-wheel yoke rod.

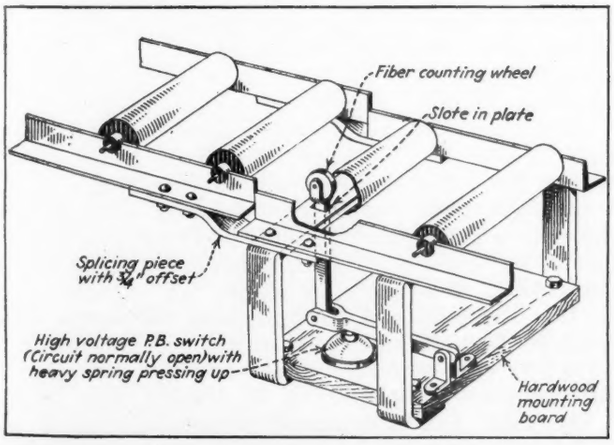
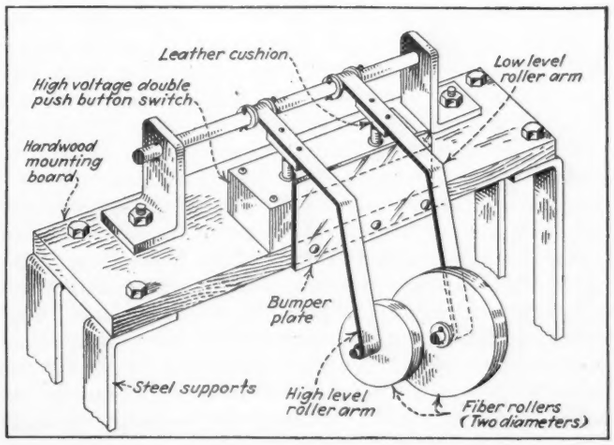

Fiber counting wheel
Slote in plate
Splicing piece with ¾" offset
High voltage P.B. switch (Circuit normally open) with heavy spring pressing up
Hardwood mounting board

FIG. 2—SUPPLEMENTAL DEVICE for remote electrically-operated counters. This arrangement was designed to count separately, three different sized packages that were traveling on the same conveyor to the shipping platform.



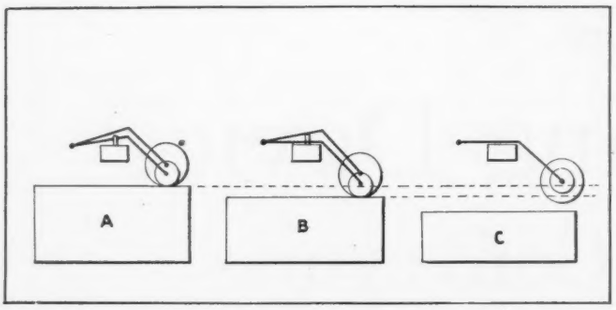


FIG. 3—RELATIVE POSITIONS OF FIBER ROLLERS and contact device. With the high box *A*, both upper circuits are closed. One upper and one lower circuit remain closed with an intermediate size box as *B*, whereas with a low box *C* both lower circuits are closed.

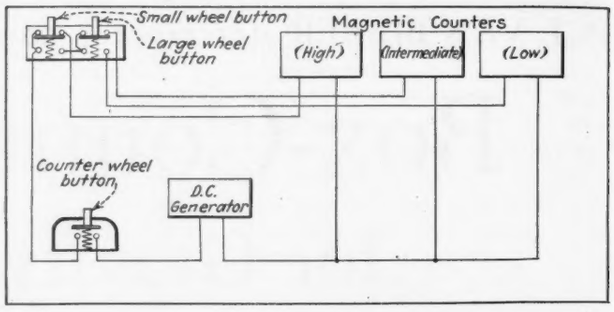


FIG. 4—WIRING DIAGRAM OF COUNTING DEVICE. Standard push-buttons actuated by counting-wheel yoke rods Fig. 3, control the magnetic counters for, high, intermediate and low sized boxes or cartons. The upper pushbutton switch is in position to count the high box.

* * * *

cuit when depressed a certain distance, but also completes another circuit in normal position, thereby acting as a double-throw switch.

The supporting frame is mounted above the conveyor line so that the rollers will have just passed over the front end of the shortest box, or carton to be counted, when the rear end of the same box has dropped off the high-level conveyor roller and depressed the counting wheel underneath. If the lowest height of package to be counted is much less than the highest, the upper wheels should clear the top by a few inches. The diameters of the wheels are proportioned so that, the highest box lifts them both slightly clear of the two push-buttons leaving the upper two circuits in the switch closed when the contact is made below by the end of the box dropping off the high roller.

The smaller of the two upper wheels must clear the next lower height of box while the larger wheel is lifted, thereby closing the lower circuit of the left-hand, pushbutton on the small-wheel side, and the upper circuit of the right-hand button. The relative positions of these wheels for the three different sized packages are shown by the use of Fig. 3 whereas, the arrangement of the electrical circuits is given in the wiring diagram.

It has been found that it is advisable to employ magnetic counters with 110-volt operating coils where they are to be placed any considerable distance from the point of operation on the conveyor system. The drop in voltage on low-potential systems of this kind is quite serious and will interfere with the accuracy of the counting. If the counters desired cannot be procured to operate on standard a.c. lighting circuit, a small d.c. generator can be belted to the nearest conveyor motor, which will insure the counters functioning as long as the conveyor system is in operation.

The Elements of Commutation

(Continued from page 176)

through the irregular field. This variation is "averaged" out so that the terminal pressure is constant, but it prevents the most effective use of the material because the maximum points impose definite limitations on the design.

Complete compensation can be obtained by distributing a portion of the neutralizing ampere-turns through the faces of the main field poles, instead of concentrating them in the interpoles.

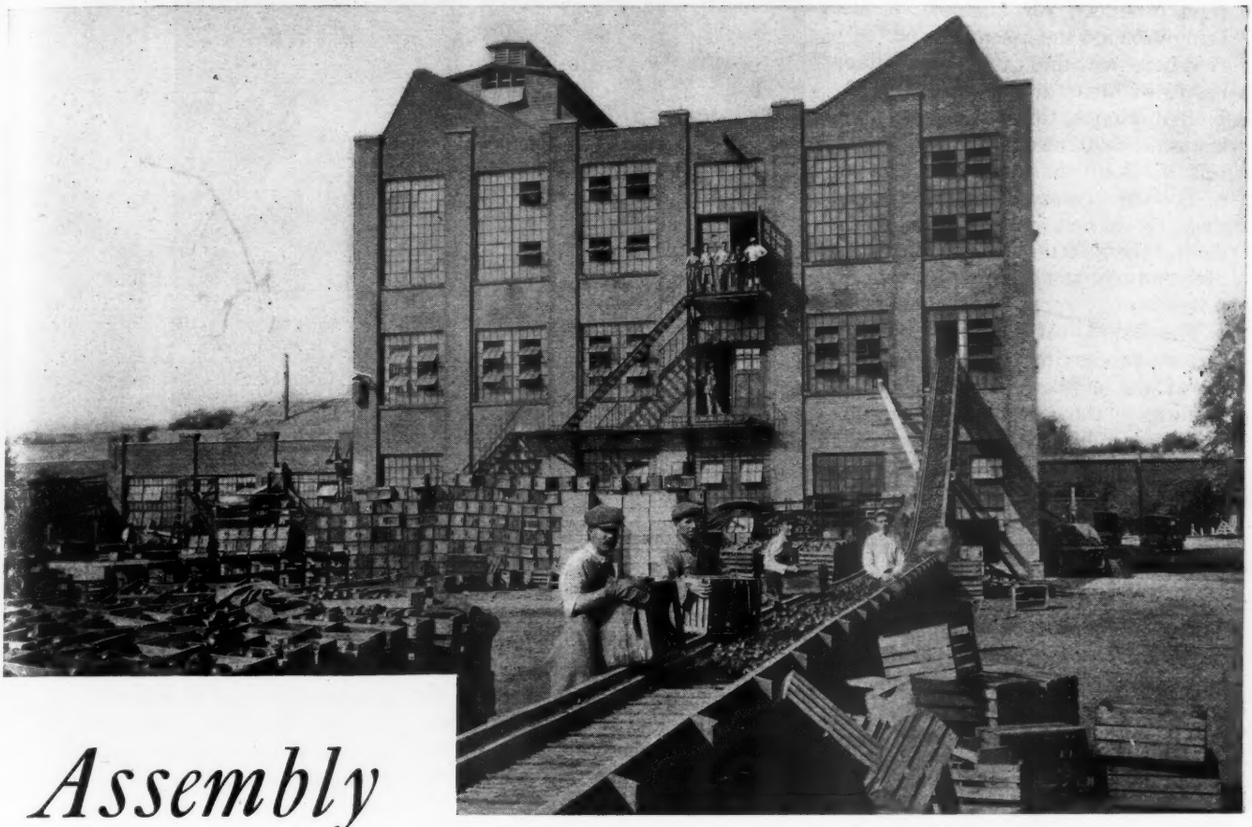
Fig. 10 shows schematically the arrangement of the windings, and Fig. 11*B* the resulting field form. It will be seen that the full-load and no-load curves are almost identical, and that the uniformity of the air gap flux distribution eliminates uneven voltages between the commutator bars. This increases the commutating capacity, and makes it possible to operate under conditions which would preclude the use of the plain interpole design. The higher cost and added complication of compensated machines limit their use to applications having severe duty cycles, as in rolling mills where extreme overloads of very short duration are quite common.

It has already been shown that in non-interpole machines satisfactory operation at full load is obtained by shifting the brushes forward (in the direction of rotation), and that this displacement from the no-load neutral introduces a demagnetizing component into the armature flux. Interpole and compensated machines are very much more sensitive to brush shifting, and rarely should be operated except with the brushes on neutral. If the corrective flux from the interpoles passes directly through the portion of the armature winding undergoing commutation, the effect on regulation will be negligible. This is evident from Fig. 12. The coils between the brushes cut the field set up by a main pole flanked by what is equivalent to two half-interpoles of opposite polarity. The total flux is, therefore, neither increased nor decreased.

If, however, the brushes are shifted forward as in Fig. 13, the air gap flux cut by the coils is equal to the difference between the fluxes generated by the main poles and the interpoles, so that the load-voltage curve will droop. With a backward shift, the addition of the interpole and main fluxes would result in a rising load voltage curve similar to that from an over-compounded machine.

Movement in either direction prevents the proper neutralizing effect and, therefore, impairs commutation. Furthermore, the rising characteristics due to a backward shift may make parallel operation with other similar machines difficult, if not impossible.

Generators and motors with interpoles are usually not provided with any brush-adjusting mechanism, and mechanical means are provided for retaining permanently the neutral position of the brushes, upon which satisfactory operation depends.



An apron conveyor elevating tomatoes from the yard to the canning room

Assembly

CONVEYORS

Cut the Cost of Foods····as well as Fords

By E. J. TOURNIER

IT IS NO LONGER a new idea to mention that the trend in the production of commodities is toward continuous operation of materials handling equipment. The fact will bear frequent repetition, however, that continuity in handling is largely responsible for cost reduction in modern production practice.

The use of conveying equipment as isolated units without relation to other operations in a process, is alone not sufficient to account for the remarkable advance of the last ten years. It is not likely that industrial processes ever will attain the continuity of a "movie" film, even by the use of mechanical handling of materials. There are many cases, however, where it was thought that the limit had been reached, only to find that further extension of the method was not only possible but profitable.

The author learned recently that a manufacturer of automobile steering column rods handled all of the assembly operations, except one, mechanically. The exception was dipping the threaded ends of the rods in grease, previous to putting on lock nuts. The workmen took the rods from the assembly line, dipped the ends in grease, then carried them to a rack located 25 or 30 ft. away, returning in time for the next rod. The manufacturer thought he had the ultimate in handling equipment. No improvement could be made. But a builder of assembly conveyors showed him that a simple chain conveyor having suitable hooks for holding the rods, would do the work of dipping and eliminate the walking. Part of the chain was made to follow a downward curve so that the suspended rods would dip into a tank of lubricant, and rise on an upward curve on the opposite end. The conveyor then continued to the end of the room where a rack mounted on a lift truck can be placed to receive the parts. One man at this point takes the rods off the conveyor and places them on the rack. The electric lift truck when loaded may be transferred direct to the shipping room. A twenty per cent saving resulted from this new link in continuity, in addition to the release of one man for other work.

For those who are associated with the automotive industry there is nothing new, perhaps, in the recital of this occurrence. It would be rather enlightening, however, to see to what extent the same general methods are being applied to other and widely different products. The preparation of

food products, for example, is also being done on the assembly line.

When we find that 20 million loaves of bread are used daily in the United States, it is interesting to translate that into terms of the barrels of flour and the quantities of milk, water and other things that must be carried and handled in producing the 8,700 tons, or thereabouts, of bread which 20 million loaves represent.

The baking of bread today is a factory process to which are applied all of the aids of science and mechanics, to the end that the product may be even better than "mother used to make." From the time flour is unloaded in bags or barrels on the receiving platform, until the bread is wrapped in waxed paper, ready for delivery, more than 85 per cent of the operations of the present-day bakery, consist of handling materials.

One of the most common forms of conveyor for handling bags consists of two strands of malleable iron or steel roller chain with wooden slats so as to form a continuous apron.

Transferring the dough in pans to the ovens is accomplished either by means of flat belt conveyors or by light double strand chain conveyors. The latest design of oven is arranged to empty the bread pans automatically onto a flat belt conveyor located close to the oven wall. This conveyor discharges to a second belt at right angles to the first, the loaves being finally delivered to a bread cooler.

This machine is a special conveyor made up of two strands of roller chain carrying between them a series of wire trays 8 to 10 feet wide. The trays are arranged in layers traveling

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A SINGLE STRAND OF CHAIN, the simplest design of conveyor, with wooden scrapers, used for handling cabbages in a sauerkraut factory.

A CONTINUOUS WOOD APRON and chain conveyor handling bags of flour. Placing flour in the storeroom and taking it out again when needed is accomplished at a small cost by this type of conveyor.

* * * *

in opposite directions the full length of the cooling room. Ordinarily the cooling period is from 90 to 120 minutes, depending on the nature of the bread. The loaves are taken away from the cooler by a system of flat belt conveyors which terminate at the wrapping machines.

The road from farm to consumer, in the case of vegetables, is also being simplified. Take the well-known cabbage for illustration. An average crop of cabbages in the United States is somewhat over thirty thousand car loads, which, we might say, forms a considerable heap. Usually the cabbages must be elevated 30 or 40 ft. and must be handled many times before they reach their various destinations.

Unloading cars is usually performed by hand labor, but reloading into carts or trucks is accomplished by means of a portable loader. Where a railroad siding is adjacent to a factory where the vegetables are to be used, some form of permanently

A BREAD COOLING CONVEYOR which handles 35,000 loaves a day. This is a type of equipment which makes possible the baking of bread by the same methods as other commodities are manufactured.

* * * *

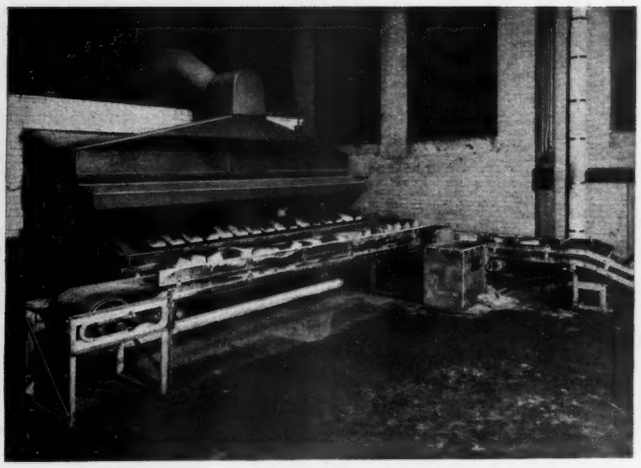
located chain conveyor is used. This is generally a single strand of malleable chain having wooden pushers or scrapers attached at intervals.

One million tons of tomatoes yearly are used for various manufactured food products. Most of this crop is placed in crates for shipment and is usually handled at destination on gravity roller conveyors and wood apron conveyors. At the cannery the ordinary method of handling is to empty the crates on the traveling apron of the conveyor, which serves as an elevator as well.

In the work room of the cannery a special form of roller chain conveyor is used to carry the preserving kettles and pans into which the tomatoes are placed for delivery to the packing machines. This conveyor is somewhat different than the types of chain conveyors previously men-

* * * *

A SINGLE STRAND CHAIN CONVEYOR of special design, equipped with holders for pans, is used to carry preserving kettles and pans.



THE TRANSFER OF BREAD from ovens to packing room is an automatic process. Specially designed belt conveyors are used by the Holland Bread Company of Toledo, Ohio, for this purpose.

tioned. In the latter, as in 90 per cent of such machines, the chain travels in a vertical plane.

The various food products which we have glimpsed, in the process of handling, both in the raw state and partly prepared, eventually reach a central distributing point. This is generally the warehouse of a wholesale grocery. In Cleveland, Boston and other large cities where the chain store system is an important link in the scheme of retail selling, these wholesale houses have found it necessary to install materials handling equipment in order to maintain their distribution schedules.

One of these chain grocery companies, in Cleveland, Ohio, with 306 retail stores, found that its growing business required larger stocks, faster moving of goods into and out of the warehouse, and that perhaps a larger warehouse would be needed. In addition, the use of hand trucks with iron wheels had damaged the concrete floors to such an extent that repairs were urgently required.

* * * *

The executives had decided that some system of handling must be installed, which would leave the floor clear for the storage of goods, for work aisles and for making repairs. This problem was solved by the use of overhead I-beam track of special design, with trolleys traveling in the lower flange. From the trolleys there may be suspended hanger rods, hooks or other forms of holders or containers for various commodities. Propulsion of the trolleys may be either manual or by means of an electric motor built integral with the trolley. In the former case a rigid frame extends below the trolley to a point near the floor and serves as a container for the load.

In the case under consideration each of the 306 stores had to be served with two orders weekly, a total of 612 store orders, requiring a total of 58 hours per week. With the new equipment the time was reduced to 20 hours with one third of the working force previously required.

Although one may speculate as to the final disposition of the 80 thousand car loads of grapes produced each year, there is evidence that great quantities are used in the manufacture of grape juice. The Welch Grape Juice Company use enough to require the aid of conveying equipment to handle these grapes rapidly and cheaply. In the lower part of the pressing and bottling building the grapes are received in boxes which are placed on a short section of gravity roller conveyor. This serves as a feeder for a wood apron conveyor terminating at a washery. The latter consists of a tank having water pipes in ladder form located some distance above. These pipes discharge sprays of water through which the fruit must pass. Between the discharge end of the apron conveyor and the washery there is another short section of gravity roller conveyor. A man standing back of this conveyor empties the boxes of grapes into the wash tank. Here they are picked up by the scrapers of a conveyor traveling in a steel trough extending to the press room above.

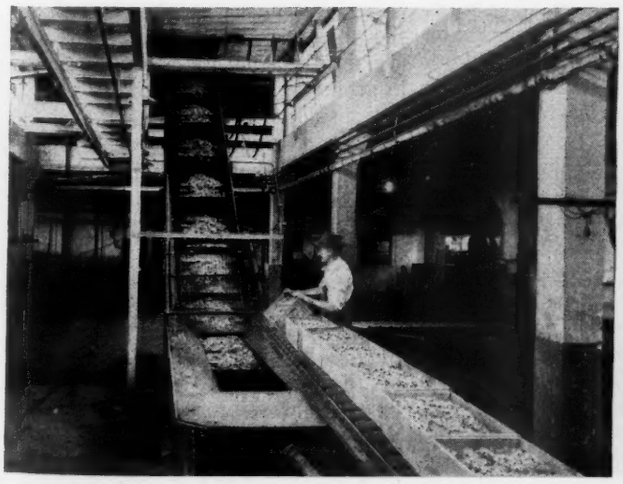
The scraper conveyor is made up of the two strands of steel roller chain traveling 30 to 40 feet per minute, and drags the washed fruit over a perforated steel trough plate.

Thus it is seen that not only cabbages and other things are helped mechanically on their way. One could show that in fact most things are handled in the same way, even from soup to nuts.

* * * *

THE COMBINATION of a gravity roller conveyor and an inclined washer-elevator is used by the Welch Grape Juice Company in washing grapes before they are delivered to the juice presses.

MAKING UP STORE ORDERS for 306 chain grocery stores, each receiving two orders weekly, amounts to moving 400 to 600 tons in seven hours. These 612 store-orders are handled by an electric tramrail.



ILLUMINATION
on a Trial Basis

How increased production and less eye-strain resulted from using mercury vapor lamps for quality knitting

By H. D. DESH
Mechanical Engineer
Holeproof Hosiery Company
Milwaukee, Wisc.

Typical arrangement of mercury vapor lamps over hosiery knitting machines

ADEQUATE and properly applied lighting is indispensable in connection with the close work necessary on fine silk textiles, if first-quality product is desired at an efficient production rate. Therefore, lighting has been given considerable atention in all of our plants which are engaged in the manufacture of both silk and rayon hosiery for men and women in various types including the high-grade full-fashioned and seamless styles.

Up to about 11 years ago individual lights were used at all the seamless knitting machines. Maintenance is always high with individual lights and a large number of them were required. Also, glare and uneven illumination on the work did not give the results desired. In addition, the movement and adjustment of the lamps wasted the operator's time.

Indirect illumination was then tried. This eliminated the shadows and glare and provided very good general illumination, but, as the paint on the ceiling became discolored, the amount of illumination on the work decreased. Also, the reflectors and lamps required frequent cleaning, thus materially increasing the maintenance cost.

About 6 years ago we tried out Cooper-Hewitt mercury vapor lamps on about half of one of the floors. At first a natural prejudice as to color was experienced from the operators; however, after running for a period of a month, they were given an opportunity to express their preference for either the indirect lighting or the mercury vapor lamps. All were emphatic for the new lamps. The operators had found that they had a more uniform light with higher intensity on the work and practically all shadows and glare were eliminated.

Before extending the use of mercury vapor lamps the records on quantity and quality of output and complaints of headaches (most of which were due to eye-strain) were compared with similar data obtained when working with indirect illumination. A noticeable increase in production and a reduction in the percentage of imperfect work resulted from the new method of illumination. In addition, the fewer complaints of headaches indicated a considerable decrease in eye-strain.

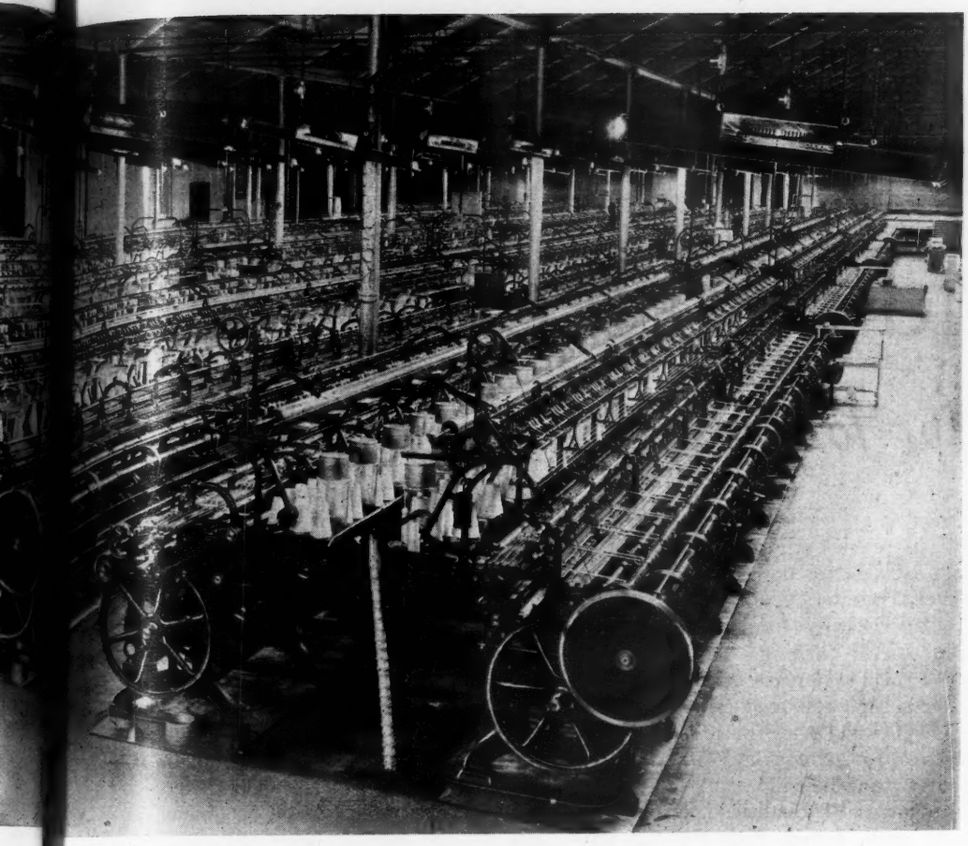
Both the management and the operators were satisfied and so it was decided to standardize on mercury vapor lamps for work where they were found most suitable, even though the first cost is higher. At present, about 700 Cooper-Hewitt lamps are in use in our plants in Milwaukee.

Mercury vapor lamps are now used exclusively for quality inspection of knitted work "in the gray," that is, before dyeing; for full-fashioned and seamless knitting; looping, and we are now trying them on seaming operations. This last class of work has been performed on sewing machines with individual lighting, together with general illumination, which has always been considered necessary. These lamps, however, cannot be used where grading or inspection according to shade or color is a factor.

The installation in our new Center St. plant embodies what, we believe, is most suitable for our work. This new plant is a single-story building with sawtooth roof and was laid out to accommodate about 80 full-fashioned knitting machines.

These machines are about 40 ft. long by a little over 3 ft. wide. They are placed back-to-back in pairs with a 3-ft. aisle between the fronts for the operators and a narrower servicing aisle between the backs, as shown in an accompanying sketch.

Considerable study was given to the proper height and spacing of the lamps and it has been found that for our work 9 ft. is the best height. Four lamps are placed on 10 ft. 8 in. centers over the operator's aisle in the length of the machine as shown in the sketch. These lamps are placed across the aisle instead of parallel, thus giving a better light distribution in the aisle and resulting in less direct light shining into the eyes of the operator in the next aisle. This gives a lamp spacing of about 10 ft.



8 in. in the aisle by 11 ft. 9 in. between aisles, with an intensity of 25 to 30 foot-candles on the work.

To absorb any vibration in the building the lamps are mounted on a semi-flexible support which gives about a 6-ft. drop. The details of the method of support are shown in an accompanying sketch. This flexibility also makes cleaning easier.

To save on the wiring cost 220-volt, 60-cycle, single-phase, mercury vapor lamps are used at the Center St. plant. Each lamp may be turned off or on by a drop pull-cord from the two-pole switch in the condulet fitting just above the lamp support, as shown in the sketch. Individual circuits control groups of four lamps which are fused and switched from central lighting cabinets.

Although we standardize on mercury vapor lights, conditions are such that we have not been able to use uniform power sources and voltages. The main plant generates its power at 110-volts, direct current. Alternating current is purchased for the branch plants at 3,800 volts, 60 cycles, three phase and transformed to 220 volts.

As a result we have 110-volt d.c. and 110- and 220-volt a.c. mercury vapor lamps in the various plants. However, the units are furnished in one size of a.c. and one size of d.c. tubes and reflectors.

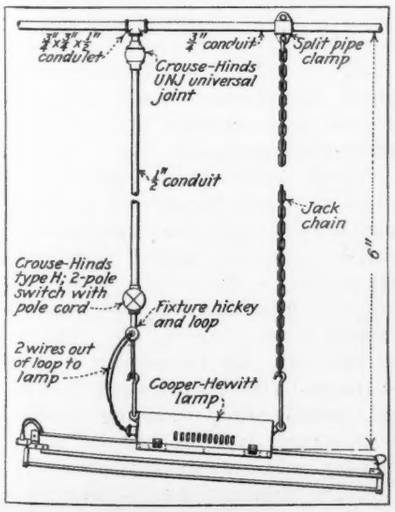
When the lamps were first installed the breakage and maintenance was somewhat high. This was largely because the men were unfamiliar with the lamps and did not realize how they should be handled. Better understanding has cured this trouble.

Lamps are cleaned every two months because the surroundings are not very dirty. A man working from a step-ladder first wipes the reflector with a moist cloth and then with a dry one. The tube is also wiped off with a damp cloth. The annaul cost of replacement and maintenance, including cleaning, is about $2 per lamp per year, although they are used both night and day.

The workers now would not be without them and we know that a definite increase in production and quality has resulted, due to the improved lighting of the mercury vapor lamp with its advantages of freedom from glare, absence of sharp, black shadows, lack of eye-strain, and its ability of showing fine detail. We feel that the performance of this type of light, properly installed and maintained, has proven to be a good investment.

* *

METHOD OF MOUNTING mercury vapor lamps. For this works the lamps are mounted 9 ft. above the floor. The method of suspension illustrated is used to provide a semi-flexible support.

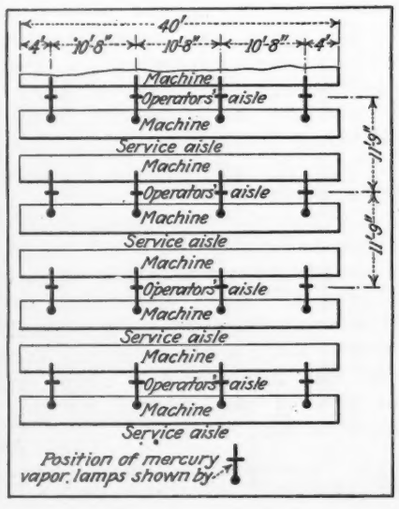


* * *

INSPECTION DEPENDS upon the illumination on the work. Mercury vapor lamps are used for all quality inspections although they cannot be used where color grading is important.

* *

SPACING OF LAMPS OVER full-fashioned knitting machines. They are placed crosswise of the aisle because they interfere less with the vision of operators in other aisles.



H. L. SCHULTZ* *emphasizes the need for*

Systematic Inspection and Service

for low pressure fuel oil systems

MODERN industrial power plants owe their remarkable records for efficiency largely to systematic and painstaking servicing under practical operation. Coal is tested for B.t.u. content as soon as it enters the siding and later checked against apparent and actual efficiency.

Water is chemically treated and brought up to predetermined specifications to insure uniform efficiency. Boilers and tubes are cleaned at regular intervals, pumps and all auxiliary apparatus is carefully inspected and adjusted. This work calls for well-planned supervision and systematic recording of facts and figures.

In spite of this the fuel oil system for ovens, furnaces and the like is often forgotten after installation and expected to function automatically, or is left to the care of some half-hearted, would-be repairman, although in many instances its magnitude and cost of operation often exceed those of the so-called power plant.

The power plant is under the guidance of a licensed stationary engineer who in moderate-sized plants is directly responsible to the plant engineer or works manager. To place the fuel oil burning layout (excluding boiler firing units) on a par with the power plant requires similar supervision.

A service man or engineer should preferably be placed in direct charge of the fuel oil system and be responsible to the plant, combustion, or maintenance engineer, or, in a small concern, to the works manager. Too much emphasis cannot be placed on the type of man selected for this important post.

*Asst. Superintendent of Maintenance, The Carborundum Company, Niagara Falls, N. Y.

The service engineer, so called for lack of a better name, should possess several inherent qualities, such as:

(1) Have a fundamental knowledge of oil burning.

(2) Be systematic and dependable.

(3) Be a fair mechanic.

(4) Have pride in his job and a desire for tinkering, practical research and development.

Some of the qualities specified here may seem rather high for the purpose, but as we study more closely the importance of the position the reasons for these qualities will be more apparent. The number of men or departments under the supervision of a service engineer will depend entirely upon conditions. Where a fair-sized maintenance department is employed a system of considerable extent may very well be covered by one man.

Responsibilities of the service engineer may be grouped under three headings:

(1) Systematic care of all equipment.

(2) Reports and statistics.

(3) Practical experiments and research.

Systematic Care of Equipment.—There is no more important part in the scheme of keeping the system running smoothly than systematic care. Much of this consists of little more than regular inspections and minor adjustments, but failure to make these inevitably spells loss and inefficient operation. The following equipment is involved: storage tanks, pumps, blowers, heaters, burners, valves, gages, air blast gates and connections, thermometers, meters, oil lines, spare parts.

Attention required by storage tanks consists mostly of inspection for leaks and cleaning out. If there are two or three storage tanks with proper inter-connections, no disruption to service will be incurred. Where tanks have been properly treated and painted, leaks should be almost unknown. After a rupture or leak has occurred, the tank should be thoroughly dried, all fumes removed, and electrically welded from the outside.

How often tanks should be cleaned will depend largely upon the grade and kind of oil used, and its relative sediment content. Generally 6 to 8 in. of slurry will collect in the bottom of the tank before reaching the suction pipe, and unless removed will cause no end of trouble. An old pump of the slurry or triplex type can often be set up for this purpose near storage tanks and will greatly reduce the cost of cleaning. When men are obliged to enter tanks, forced ventilation must be used to remove the deadly fumes that accumulate. As an added precaution, provisions should be made for the quick removal of one who may be overcome.

Pumps should be set up in duplicate, and a third, spare, pump should be on hand, as a stand-by for emergencies at all times. When pumps are directly driven, it will be advisable to use a complete unit with the motor mounted on the base.

Where continuity of operation is a factor, a spare blower unit in addition to the duplicate will provide double precaution against shutdown. Regardless of the nature of repairs required internally by the various impeller-type blowers the fundamental cause for failure can usually be traced to the bearings not holding up. A little study, resulting possibly in a special type of ball or roller bearing, will remedy most troubles. With the turbine type of blower prac-

FUEL ON CONSUMPTION REPORT

WEEK ENDING ____ BLDG. NO.— ____ BAUME

	SUN.	MON.	TUES.	WED.	THURS.	FRI.	SAT.	TOTALS
INLET METER NO. GALS. REG. AT START L 1								
OUTLET METER NO. GALS. REG. AT START L 1								
INLET METER NO. GALS. REG. AT FINISH L 2								
OUTLET METER NO. GALS. REG. AT FINISH L 2								
TOTAL CONSUMPTION								
TOTAL HOURS								
TOTAL BURNER HRS.								
AV. TEMP. OIL*—F								
AV. OIL PRESSURE #/0								
AV. AIR PRESSURE OZS.								
AV. BURNER CONSUMPTION PER HOUR								
ROTARY ROASTER 1	*							
	*							
DRYER NO. 1-2-3-4-5								
DRYER NO. 6-7-8-9								
HEAT TREATERS NOS. 1-2-3-4								
HEAT TREATERS NOS. 5-6-7-8								
FURNACE NOS. 1-2-3-4-5								
MISC. USE								

REMARKS: *—Meter readings at beginning and end of run.
L—Loop.

FIG. 1—THIS DAILY FUEL OIL REPORT gives complete information on the operation of the system.

FUEL OIL CONSUMPTION REPORT

LOOP NO. 1 FOR WEEK ENDING..... 19...

BUILDING	TOTAL CONSUMPTION	TOTAL HOURS	TOTAL BURNER HRS.	AV. TEMP. OIL—F°	AV. OIL PRESS—#/0"	AV. AIR PRESS— OZ'S	AV. BURNER CONS.—HR.

REMARKS: HIGHEST AV. FOR ONE DAY = ...
LOWEST AV. FOR ONE DAY = ...

LOOP NO. 2

REMARKS: HIGHEST AV. FOR ONE DAY = ...
LOWEST AV. FOR ONE DAY = ...

LOOP NO. 3

REMARKS: HIGHEST AV. FOR ONE DAY = ...
LOWEST AV. FOR ONE DAY = ...

FIG. 2—DEPARTMENT HEADS find a weekly summary report helpful in keeping costs down.

* * * *

tically no attention is required other than replacement of bearings.

Too much emphasis cannot be given to the importance of regularly cleaning and examining burners, which should be removed, taken apart, and thoroughly brushed with gasoline to remove all carbon and foreign deposits. Burner tips most be closely watched and in many cases frequently replaced, to insure desired uniformity of flame.

Little more than inspection, with minor adjustments or replacements, is necessary on heaters, gages, and thermometers.

Shut-off and gate regulating valves require practically no attention. However, all needle valves should be occasionally taken apart and cleaned. Anti-syphon valves, automatic air-oil shut off valves and all safety and automatic oil control valves must be tested for proper functioning.

The air system is one important element that is often overlooked. Air blast gates occasionally become worn and the best of soldered joints on bends and connections will sometimes loosen up under building vibrations. Leaks tax the blowers heavily and lower the over-all efficiency.

There is no more delicate part of the layout than the meters, but with a fair amount of care no trouble should be met. Meters require checking and testing, both individually and in pairs, when used on a loop system. They may be tested in pairs by running for a predetermined time, checked by a stop watch, and recording the amount passing through, and then individually by passing the fuel oil going through the meter into a calibrated drum or tank at the same pressure used in operation. Meters, regardless of type, will in time show some discrepancies, due to wearing of the train gears; when this occurs the latter can be replaced. Replacements may, however, be minimized by keeping meter strainers clean.

Records and Reports—Only such records and statistics should be kept as will aid in continually checking the results obtained. Oil consumption per burner hour, or per unit of product must be closely watched—as must cost of maintenance, depreciation, and the advisability of making replacements. The fact that the system operates smoothly does not necessarily mean that it is working at the

(*Please turn to page* 204)

* * * *

FIG. 4—THE AMOUNT of liquid in a horizontal tank can be determined from this chart. Starting at the left, place a ruler, as indicated by the dotted lines, at the proper points on the columns representing diameter of tank, depth of liquid, etc., and read number of gallon on column G. This chart can be used for any horizontal tank up to 100,000 in. in length and from 2 to 200 in. in diameter.

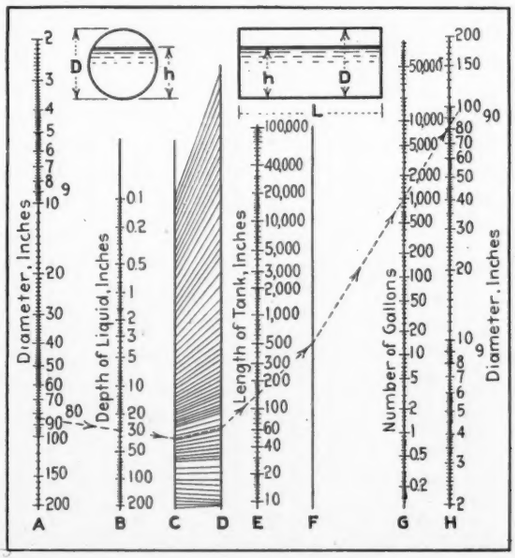
* * * *

FIG. 3—MONTHLY REPORT of fuel oil consumption by departments. This report is used by the accounting department in distributing costs, and also placed in the general files for reference.

MONTHLY FUEL OIL CONSUMPTION

The crude oil consumed during March, 1927, should be allocated as follows:

5107 gals.	Drying Kilns—section H	Chg. No. 345
8526 gals.	Drying Kilns—section L	Chg. No. 354
2041 gals.	Muffle Furnace Dept	Chg. No. 741
3227 gals.	Heat Treating	Chg. No. 248
2226 gals.	Research Dept.	Chg. No. 277
4452 gals.	Forge and Blacksmith Shop	Chg. No. 243
25579 gals.	Total Consumed	



INDUSTRIAL ENGINEERING
with which is consolidated
INDUSTRY ILLUSTRATED
Electrical, Mechanical and Plant Service in Industry
Published by the McGraw-Shaw Company

New York, April, 1928

When Planning New Work Provide for the Inevitable Rearrangement

IF EQUIPMENT and machinery would only "stay put" and never have to be shifted around, it would eliminate much of the grief of the maintenance department. However, every plant man knows that changing production demands necessitates the rearrangement of the layout and machine grouping. Some industries, such as the automotive, have extensive rearrangement programs annually in connection with new models.

The amount of work involved in these shifts depends upon how well they have been anticipated in the original layout. Sometimes a slight shift necessitates almost as much work on the auxiliary air, steam or water lines or on the electrical distribution circuit as in the original installation.

Where an entire electrical distribution line must be torn out completely and replaced when a properly designed circuit could have been arranged to tap off at convenient distances, the extra expense of one shift would more than pay for the additional first cost of the better arrangement.

The advantages of planning ahead for possible future changes, which under present-day production conditions are almost inevitable, should be given serious consideration in laying out any new electrical work, pipe-lines and similar systems.

Give the Maintenance Department A Sporting Chance

COMMENTING on the fact that a recent flood had caused a shutdown for the first time in ten years, the superintendent of maintenance in one plant said: "The management gives us everything we want, regardless of cost, but will not accept any excuse whatsoever for a shutdown. Our jobs depend strictly on our ability to keep the plant running all of the time."

This is an enlightened attitude that the management of many plants could adopt to their advantage. To ask the maintenance force or any other department, to struggle along with inadequate facilities is both discouraging and unfair to conscientious men who are anxious to do a good job. Nor is it fair to ask them to keep production going in a plant that is filled with antiquated machines, or cheap, inferior equipment that has been bought after shopping around to find the lowest bidder.

Quality products inevitably cost more than those that are sold almost on the basis of so much per pound. Into the former go more engineering skill and experience, better materials, finer workmanship. Out of them naturally come a correspondingly greater measure of reliable and efficient service that spells low maintenance and production costs.

Any red-blooded operating or maintenance executive will gladly accept the challenge to keep his plant operating continuously. However, he is entitled to the sporting chance that can be given only by allowing him to purchase equipment that he knows is dependable, and giving him the proper facilities for taking care of it.

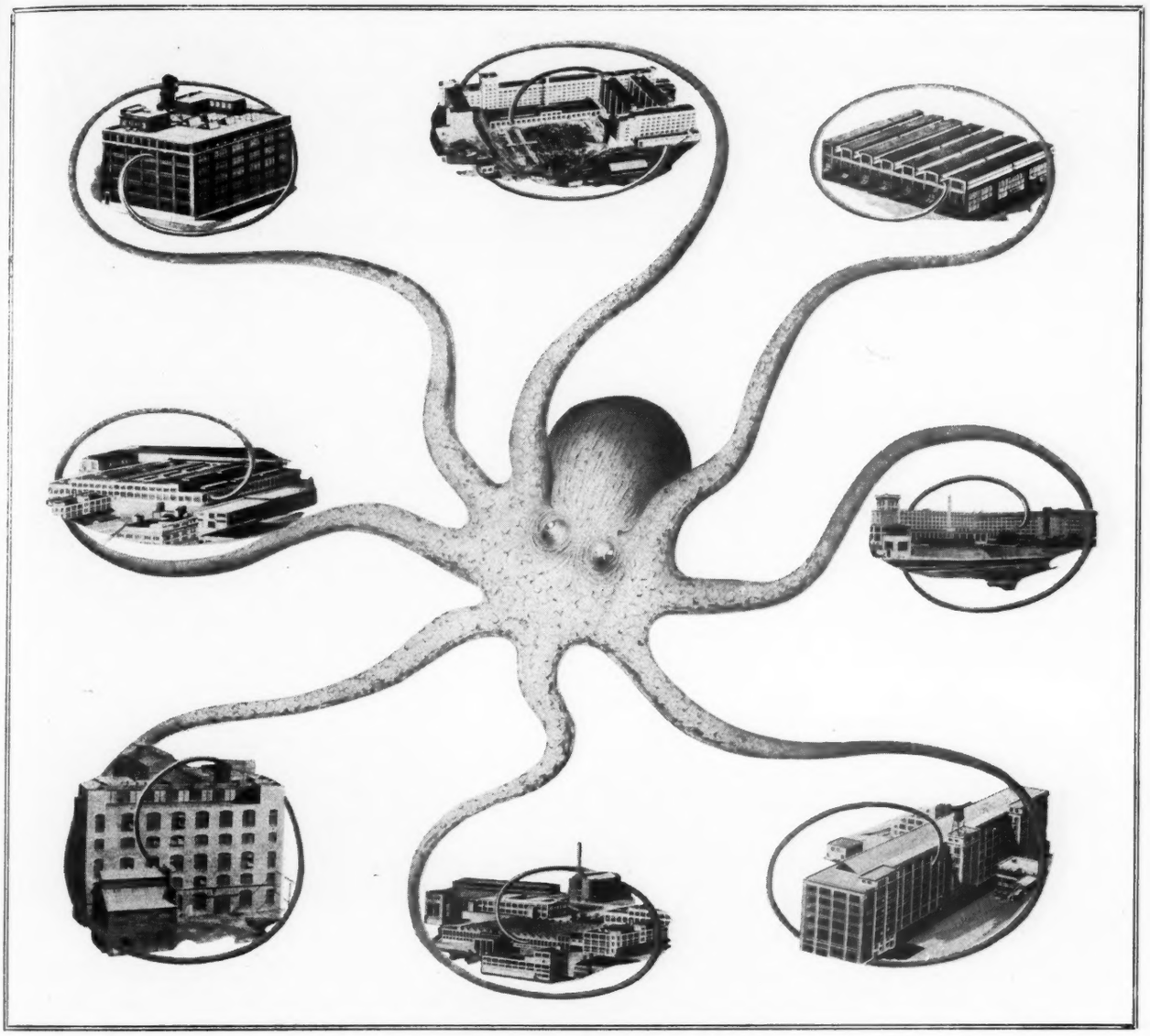
Investigate Offers of New Positions Before Making a Change

FREQUENTLY the head of an operating department in an industrial plant or his assistant receives an invitation to take charge of similar work in another organization. Such opportunities should receive serious consideration and a personal investigation, wherever possible, before acceptance. Much more important is the attitude of the man responsible for the management of the company toward the importance and responsibility of the operating departments.

A candidate will find that a conference and at least a trip through the plant and the shop or department which is to be his headquarters will give him a good picture of the conditions he must face.

A high turnover of predecessors indicates, generally, that something is wrong in the management or the company policies, as was the case in one plant which had almost a procession of chief electricians in and out. The trouble lay in the company's method of cost accounting which charged all electrical equipment upkeep and repairs to the electrical department. The department heads using the equipment had no interest in its care or how much its maintenance cost and banded together to prevent a change which would add to their production costs. As a result the chief electrician soon had to give up and quit or was fired.

Probably few plants have this difficulty but any man who plans going into new surroundings or conditions should have a clear understanding beforehand as to the policy of the company and the attitude of the man to whom he is to report. Also, the extent of his own responsibilities and authority can be discussed and established more easily beforehand than later. The old adage, "Look before you leap," applies just as well to a man's everyday work as to matrimony.



Feeding the Octopus

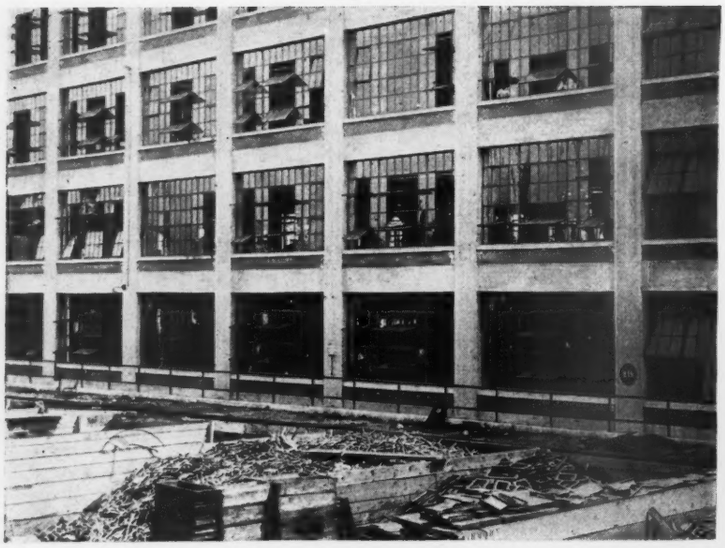
Dreaded by sailors and fishermen of the sea is the octopus. His slimy tentacles close stealthily about his victims in an irresistible grip, holding them fast while he sucks their life blood.

There is an invisible but dangerous octopus living in every industrial plant. In many of them the monsters thrive and grow fat. In a minority of plants they find slim pickings.

The name of the industrial octopus is *waste*. It is the plant engineer's duty to find what he feeds on and starve him out.

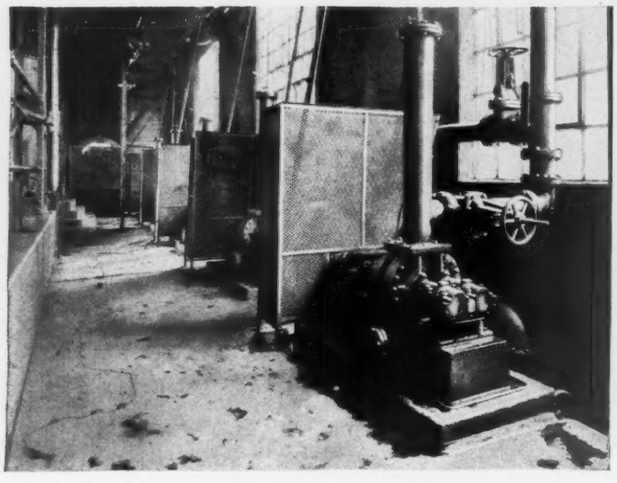
On the following pages you will find suggestions for fighting this octopus.

Feeding t



Dirty windows and skylights are the octopus' delight, for he knows that they slow down output, increase spoilage and multiply the wastes on which he thrives.

The waste octopus grows fat on improper handling methods. He likes to see the workmen lift and carry. It means more "dead" expense, on which he can thrive.



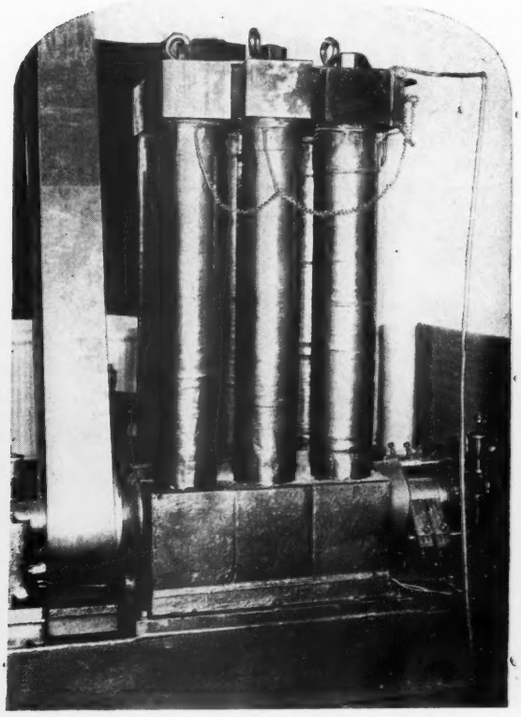
Worn and rutted shop floors tickle the taste of the waste octopus because they exact their tribute of unnecessary labor from every passing truckload.

Bad ventilation and poor heating provide rich fodder for the waste monster, because they affect the entire working force on a wholesale basis

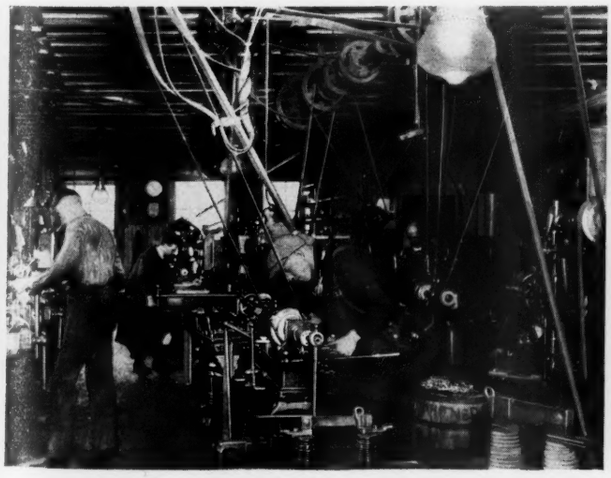
the Octopus

Poor maintenance has bettered many a waste octopus at the expense of wages and profits. Regular inspection of buildings and equipment discourage his appetite.

The waste octopus thrives on unnecessary steps. It does him good to have a workman walk a hundred yards for a drink of water.



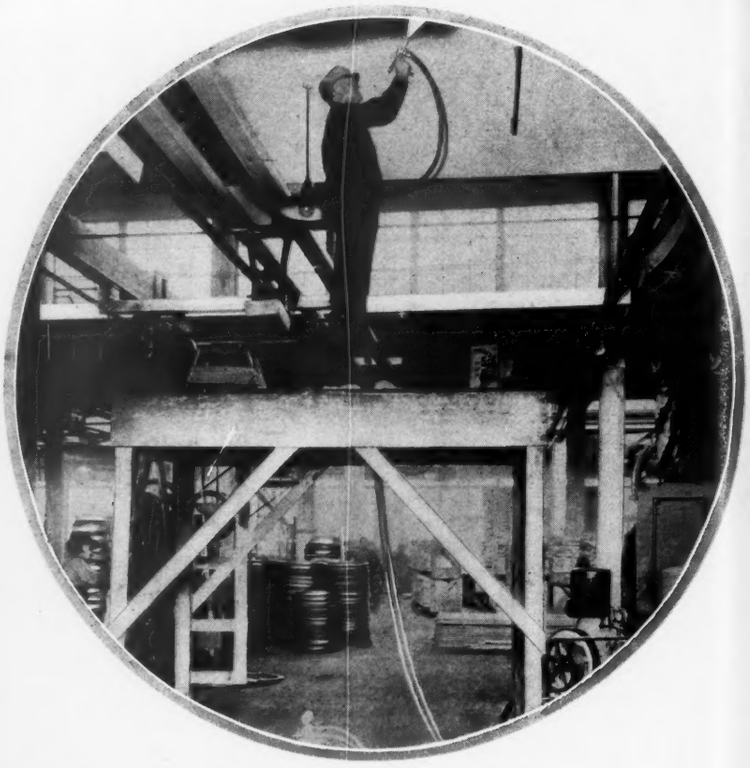
The octopus of waste grows fat on obsolete equipment. Every hour that it is kept in use means a full meal for him. Check up your equipment with this thought in mind.



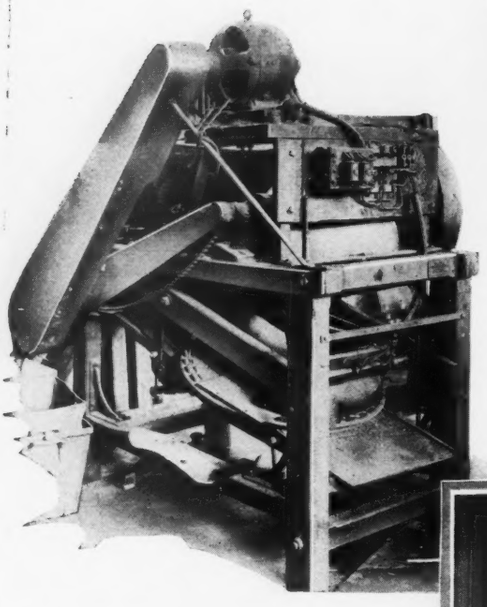
Faulty mechanical transmission, slipping and rapidly wearing belts, overloaded gears and improper driving speeds please the waste octopus.

Poor artificial lighting gives the octopus of waste a thrill, and adds a pleasing dish to his daily menu, especially on dark days and during the winter months.

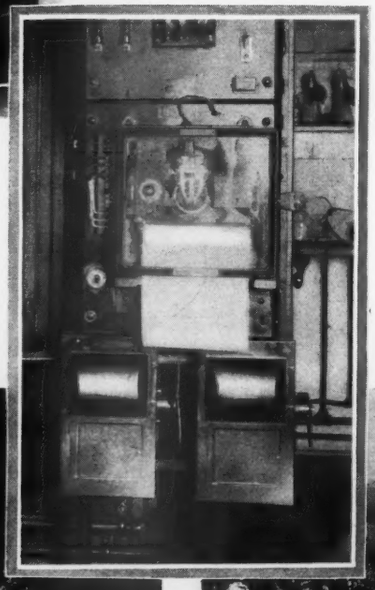
Feeding the Octopus



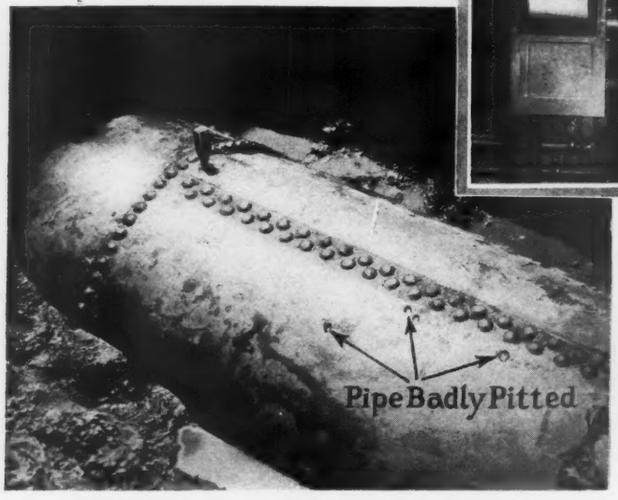
The hidden waste octopus hates a paint brush on general principles. He knows that there will be slimmer picking for him in those plants where neatness and cleanliness are habits.



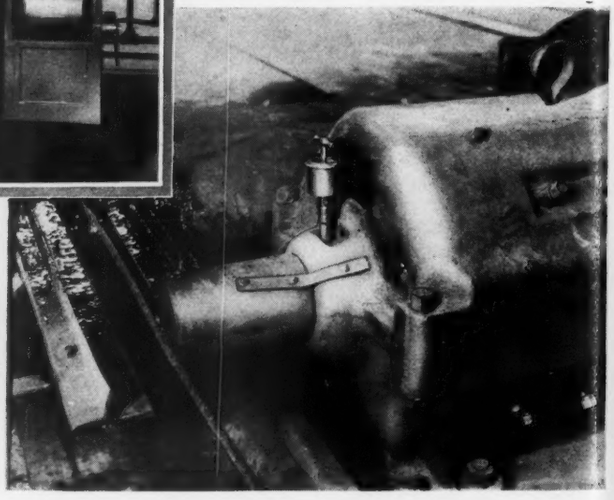
Improper selection of motors and electrical control apparatus provide the waste octopus with a tasty dish. He loves underpowering of equipment because it multiplies his food supply.



A low power factor in the plant puts the waste octopus in high spirits. He knows that it means more food for him and less wages and profits in the plant.



Compressed air leaks and losses spice the meals of the waste octopus. Like him, they are invisible but very real and often present.



Faulty lubrication is gravy for the octopus. Friction and rapid wear furnish him with succulent food at the expense of the profit statement.

Modern Machinery . . . *and* Unemployment

Mechanization creates new jobs and builds prosperity

STATEMENTS recently made that the great increase in the use of machinery is a prime factor in creating unemployment have been challenged by Magnus W. Alexander, president of the National Industrial Conference Board. Such utterances as "machinery makes idle hands" or "the price of industrial progress is unemployment" he characterized as reflecting confused thought.

"Such an interpretation of the relation between machine production and employment," Mr. Alexander continued, "is not new. It was at the bottom of the opposition of English labor when the introduction of power looms and other power-driven machinery brought about what the textbooks refer to as 'England's Industrial Revolution.' Local unemployment may temporarily ensue as the result of rapid changes in production processes. Usually, however, mechanization proceeds slowly and allows, therefore, simultaneous adjustment.

"What I wish to emphasize, however, is the permanent effect of mechanization on our national economic life and on the economic and social status of the wage earner. As to this effect it is important to analyze concretely the situation as the National Industrial Conference Board has found it by its study of the latest available comprehensive data—those revealed in the United States Census of Manufacturers for 1925.

"At that time, 71 wage earners instead of 100, and 82 managerial and supervisory persons instead of 100, produced the same physical volume of production as was obtained in 1914. Nor was this productivity of the wage earners achieved by longer hours or harder work. In fact the number of working hours in 1925 per wage earner were about 9 per cent less than in 1914 and yet the output was actually 40 per cent greater. A study of several hundred corporation returns leads me to say that this general picture holds good also for 1927, perhaps even to an increasing degree.

"The very pertinent question arises as to what has become of the 29 per cent of workers without whom the same amount of production is now being carried on as compared with 1914? The answer is that although productive output per wage earner between 1914 and 1925 had increased by about 40 per cent, the total manufacturing production during the same period increased over 65 per cent and necessitated an increase in the required labor force of about 1,500,000 wage earners.

"In other words, while 71 men in 1925 did produce as much as 100 men did in 1914, the demand for manufactured goods at their lower production cost and correspondingly lower selling price expanded sufficiently to re-absorb not only the 29 per cent of workers theoretically released, but in addition called 1,500,000 workers into action.

"It is a well-demonstrated economic principle that increased production creates new wants and that new industries bring with them new demands for both materials and services. The automobile and radio industries, to take two outstanding examples, have not only directly absorbed many workers from other industries and by the requirements of an immense amount of raw materials have given many additional workers employment with material manufacturers, but they have also created demands for many new products such as accessories and in the servicing and distribution of the merchandise.

"Five new major industries alone which have been developed in the last twenty years, during which mechanization of industry has had its greatest development, namely, the automobile, the motion picture, radio, chemical and electrical industries now give employment to some 30,000,000 people.

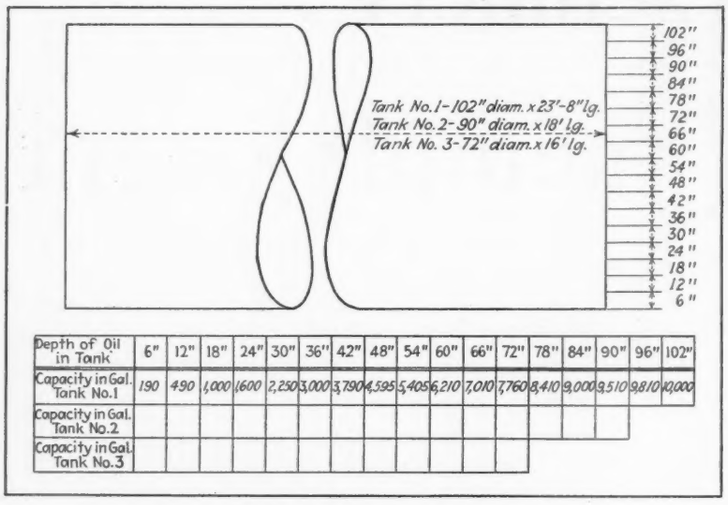
"At the present time wages in manufacturing are considerably more than doubly as high as they were in 1914, while the cost of living is only about 63 per cent above the level of 1914. The net result is that the real wage, that is the net purchasing power of the wage which the average industrial worker receives, is now one-third greater than it was just prior to the beginning of the World War.

"In other words, the worker of today performing the same class of work in fewer hours of the week, can buy with his weekly wage fully one-third more of the same goods of the same quality in 1914, or correspondingly, can buy goods of higher quality than he could afford to buy in 1914.

"The wage-earning population is therefore in a better position to cope with temporary unemployment than it has been in our industrial history prior to the World War, when opportunity for saving money was considerably smaller. With a population of about 98,000,000 in 1914, the savings bank deposits in banks, building and loan associations assets and life insurance premiums—all forms of savings of the great mass of the people—aggregated $14,700,000,000, and in 1926, with an estimated population of 118,000,000, they amounted to $43,800,000,000. "Taking into account the population increase, the growth in savings in the short span of thirteen years was nearly 150 per cent per capita of population."

Systematic Inspection and Service

(Continued from page 197)



Depth of Oil in Tank	6"	12"	18"	24"	30"	36"	42"	48"	54"	60"	66"	72"	78"	84"	90"	96"	102"
Capacity in Gal. Tank No.1	190	490	1,000	1600	2,250	3,000	3,790	4,595	5,405	6,210	7,010	7,760	8,410	9,000	9,510	9,810	10,000
Capacity in Gal. Tank No.2																	
Capacity in Gal. Tank No.3																	

FIG. 5—A CHART like this may be drawn up when only one of two tanks are used.

* * * *

FUEL OIL ANALYSIS REPORT

Material	Fuel Oil—Penna. 36/40° Spec. Grav.	Quantity ..	1 T/C
Shipper	West Penn Oil Co..	Lot or	
Date of Shipment	12/20/26 Via. NYC Erie	Car No....	SDRX 30811
Test Against		Order No...	N 8759
For Department	X and Y To be used for		
Remarks			

ATTACH THIS SLIP TO SAMPLE OF ABOVE, WHEN RECEIVED, AND FORWARD TO ANALYTICAL LABORATORY AT ONCE.

No. LM—421

Material Received
Date 12/21/26

Specific gravity	.826
Degrees Baume	39.5
B.T.U. per lb.	19,830
Flash point	97 C-207 F.
Sediment	trace
Visc. at room temp. ..... (24 c)	23 sec.

FIG. 6—CHEMICAL ANALYSIS of the oil is reported on this form.

* * * *

maximum efficiency. Simple reports may be drawn up that will present to the engineer or superintendent a bird's-eye view of the entire situation.

Fig. 1 represents a fuel oil consumption report that covers operating and mechanical conditions as well. The report shown covers a two-loop system and when properly filled in supplies complete information. Any unusual or abnormal conditions are immediately noticed and investigated. This report is made out by the service man or engineer and turned in weekly to his superior. To this report may be added the amount of product and the fuel oil consumed, as a check on the efficiency. Under remarks are noted repairs that were found necessary or any useful information.

A summary of report No. 1 is shown in Fig. 2. It may be used for giving data wanted by the heads of production departments. This report bears close watching and may be a great aid in getting the co-operation of departments in keeping cost down.

Fig. 3 illustrates still another form for recording oil consumption. This covers a period of one month and shows the amount of oil used by various departments. A report similar to this may be forwarded monthly to the cost department for proper distribution and a copy filed for making comparisons between the amount of oil consumed and the work turned out. This procedure will save considerable time that would otherwise be required if one were obliged to go through the detailed, daily or weekly reports. It will be noted that this report is as simple as possible and that all detail has been eliminated. Where facts and figures indicate a reason for investigation the charts referred to can be consulted.

As a double check on consumption it will be necessary to take, say monthly, a record of the oil on hand, and deduct it from the amount on hand the previous month and purchased since.

The chart shown in Fig. 4 is a valuable time-saver in taking tank readings. The depth of oil in the tank is shown by the level indicator and the amount in gallons read directly from the chart. When only one or two storage tanks are used a chart similar to that shown in Fig. 5 will often suffice.

An accurate record of all purchased fuel oil of the characteristics should be kept, for this is only one of the many variables that may have quite a bearing on consumption. Fig. 6 shows a report that fully covers the essential information desired. The oil shown on this report was found to be considerably lighter than the purchase order called for, and a considerable increase in consumption was noted. However, an investigation was immediately made, with the result that oils purchased thereafter were of the proper grade.

It is advisable to make several test runs with oils of different degrees Baumé to compare their efficiencies. Fig. 7 shows the results of such trials properly tabulated for reference purposes.

Experimental Work. — Much of the practical work of an experimental nature must be carried on in the field. The service engineer can, after some experience, be of great help in development work, as he is in close contact with the every-day problems of operation. Only brief mention can be made of the ground to be covered.

* * * *

FIG. 7—A CONVENIENT form for reporting results of tests on oils of different gravity.

FUEL OIL CONSUMPTION—COMPARISON BY BAUME

READING NO.	—1—	—2—	—3—	—4—	—5—	—6—	—7—	—8—			
BAUME	23°	28°	30.1°	30.4°	31.5°	34.3°	37°	38°			
AV. CONS. BLDG. DEPT. X	10.00	10.63	9.8	10.66	10.88	11.01	11.09	12.3			
AV. CONS. BLDG. DEPT. Y	9.50	10.27	11.4	11.2	10.87	13.12	13.17				
GENERAL AVERAGE	9.90	10.45	10.6	10.93	10.87	11.06	12.13	12.3			
REMARKS											

Bits of NEWS
from Here and There

Secretary of General Electric Company Retires

Myron F. Westover, secretary of the General Electric Company for the past 34 years, retired on March 1 and William W. Trench, assistant secretary, has been elected by the board of directors to succeed him. Mr. Westover has been actively identified with the electrical industry for 40 years, his first position being secretary to the late Charles A. Coffin, then treasurer and manager of the Thomson-Houston Electric Company. He was associated with Mr. Coffin until Mr. Coffin's death in 1926.

Mr. Trench, the new secretary, is a native of Staten Island. He is 36 years of age, a graduate of St. Lawrence University, the Brooklyn Law School and was admitted to the bar in 1916.

Engineering Tour to Europe

BULLETIN No. 111 of the School of Foreign Travel Inc., 110 East 42nd Street, New York, N. Y., outlines an engineering tour to Europe, for factory and public utility executives, instructors and students in engineering colleges, and others interested in business, industrial and engineering problems, who wish to study these subjects under expert direction, and, at the same time, have the opportunity of seeing how these various problems are treated abroad.

College credit if desired is offered in Industrial Engineering and Mechanical Engineering.

The courses given on the tour will use as illustrations for the lectures and conferences, the power plants, factories and industrial organizations visited and the course of the itinerary has been planned to give the widest contact possible with the leading industrial sections of England, Belgium, Germany and France.

Visits will be paid to typical factories and plants, and conferences arranged with representative European engineers and factory executives. American and European methods and technique will be compared, and the members will have the opportunity of examining and comparing foreign practice and processes.

The faculty will consist of:

N. C. Miller, B.M.E. (Michigan), M.S. (Penn State), Director of Tour, Director of University Extension Division, Rutgers University, The State University of New Jersey.

J. A. Moyer, S.B. (Harvard), A.M. (Harvard), Lecturer on Mechanical Engineering, formerly Junior Professor of Mechanical Engineering, University of Michigan, Director University Extension, Massachusetts State Department of Education, Boston. J. O. Keller, B.S. (Penn State), M.S. (Penn State), Lecturer on Industrial Engineering, Professor of Industrial Engineering, Pennsylvania State College, and Head of the Department of Engineering Extension.

BUSINESS ITEMS

BARBER-GREENE COMPANY, Aurora, Ill., manufacturers of standardized material handling machines, announce the opening of a new branch office of 431 Temple Bar Building, Cincinnati, Ohio. This branch will be under the supervision of Mr. Paul Frederick, as district manager, who was formerly sales engineer in the Detroit office.

UNITED CONVEYOR CORPORATION of Chicago, Ill., announce the purchase from the Conveyors Corporation of America of all patterns, designs, manufacturing rights and patents for the American Steam Jet Ash Conveyor, the American Cast-Iron Storage Tank, American Air-Tight Doors and the Steam Jet Ash Conveyor business of its predecessors: American Steam Conveyor Corporation, Green Engineering Company, Gertanner-Daviess Company, Company, Griffin Engineering Company.

ELECTRIC MACHINERY MANUFACTURING COMPANY, Minneapolis, Minn., manufacturers of electrical power apparatus, announced the appointments of Mr. L. Brandenburger, 149-151 W. Second South, Salt Lake City, Utah, as their Salt Lake City representative; and Mr. R. K. Poppleton, Inc., 35 First Street, Portland, Oregon, and 2963 First Avenue South, Seattle, Wash., as their Portland and Seattle representative. These appointments are for the purpose of making their equipment more readily available to users in the Northwest.

THE LOUIS ALLIS COMPANY, Milwaukee, Wis., manufacturers of d.c. and a.c. motors announce the opening of a district sales office in the Union Building, 1836 Euclid Avenue, Cleveland, Ohio. Mr. W. F. Glaser has been appointed district sales manager of the branch.

THE EQUIPMENT & SUPPLY COMPANY, P. O. Box 110, Baxter Avenue Station, Louisville, Ky., announce the opening of offices and display rooms for Esco Service as manufacturers agents for mechanical equipment, machinery, construction materials and supplies. Eugene J. Strads is in charge.

THE FUSION WELDING CORPORATION, which operates as the Welding Equipment and Supply Division of the Chicago Steel and Wire Company, 103rd Street and Torrence Avenue, Chicago, Ill., announces that its new engineering and research laboratories are now completed. These laboratories include a well-equipped work room supplied with various forms of a.c. and d.c. for welding, as well as oxyacetylene cutting and welding equipment for weld testing and welding rod development. There is also a photographic darkroom equipped with

Prominent Engineers and Scientists Plan Tokio Congress

MEMBERSHIP on the American Committee of the world congress of engineers to be held in Tokio in November, 1929, has been accepted by seventy-eight of the nation's most prominent engineers and scientists, Elmer A. Sperry, Chairman of the National Research Council, announced recently.

Almost every activity of daily life as touched upon by modern science and invention will be reflected in the deliberations of the congress.

Among members of the American Committee appointed by Secretary of Commerce Hoover, honorary Chairman of the committee are, Thomas A. Edison, John Hays Hammond, Samuel Insull, William B. Mayo of the Ford Motor Company, Charles M. Schwab, Gerard Swope, President of the General Electric Company; Samuel M. Vauclain, President of the Baldwin Locomotive Works; Orville Wright, General William Barclay Parsons, James H. McGraw of the McGraw-Hill Publishing Company, H. H. Westinghouse of the Westinghouse Air Brake Company, Alfred Sloan, Jr., President of the General Motors Corporation; Professor Michael I. Pupin of Columbia University and William Green, President of the American Federation of Labor.

the latest type of metallographic microscope. Another room contains the necessary desk and office equipment for the engineers, as well as a library and provision for projecting lantern slides and motion pictures.

OVEN EQUIPMENT & MANUFACTURING COMPANY, New Haven, Conn., manufacturers of industrial ovens for the past twenty-five years, has changed its name to The Crawford Oven Company as of December 15, 1927. The company takes its name from that of Ronald Crawford, its founder, vice-president and general manager from 1902 until his death in 1920. The founder's two sons, who have been connected with the company for some time will manage the business. R. M. Crawford is president and sales manager. E. B. Crawford is vice-president and treasurer.

THE DU PONT CELLOPHANE COMPANY, on January 1, moved their main sales offices from 40 West 40th Street, New York City, to the new Park Avenue Building, located at 32nd Street and Fourth Avenue.

THE WAGNER ELECTRIC CORPORATION announces the opening of a sales office at 1006 Washington Ave., Houston, Texas. Warehouse stocks are carried at both Houston and San Antonio. Mr. W. B. Arbuckle has been placed in charge and will look after the corporation's business in that part of Texas, known as South Texas which includes Beaumont, Houston, San Antonio and south to the Rio Grande.

THE ELECTRO-NITE CARBON COMPANY, Philadelphia, Pa., manufacturers of carbon brushes for motors and generators announce that their Michigan office, located in the Basso Building, 7338 Woodward Avenue, Detroit, is now in charge of Mr. A. G. McMann.

THE AMERICAN ELECTRIC SWITCH CORPORATION, Minerva, Ohio, announces the acquisition of The Nyelec Switchboard Company, 422 East 53rd Street, New York, N. Y. The Nyelec Switchboard Company will retain their New York office, factory and personnel and will operate as The Nyelec Division of The American Electric Switch Corporation. The sales for the present will be handled by The American Electric Switch Corporation Sales Organization. The Nyelec Company was organized in 1907 as The New York Electric Light & Engineering Company.

ALLIS-CHALMERS MFG. CO., Milwaukee, has opened a new district sales office at Phoenix, Arizona, covering the States of Arizona, New Mexico and northern part of the Republic of Mexico. The office is located at 308 Heard Building, with J. B. Cooper as manager. Mr. Cooper's headquarters were formerly in Los Angeles. A branch office has been opened at San Antonio, Texas, 619 Frost National Bank Building, with Mr. Earle R. Hury in charge. This is a branch of the district office at Dallas. A branch office is also being opened at Grand Rapids, Michigan,

PERSONAL MENTION

CHAS. E. STONE, since 1924 vice-president of the Interstate Drop Forge Company, manufacturers of drop forgings, Milwaukee, Wis., has been elected president, succeeding C. R. Messinger who is a member of the board of directors and president of the Chain Belt Company. Lamar S. Peregoy was elected vice-president. C. C. Bremer and J. C. Merker were re-elected treasurer and secretary respectively.

CHAS. E. STONE

Prior to his office at the Interstate Drop Forge Company, Mr. Stone was associated with the Chain Belt Company, Milwaukee, Wis., first, as purchasing agent and later assistant to president.

He is also a director of the Nugent Steel Castings Company of Chicago. C. R. Messinger, W. C. Frye, Clifford F. Messinger, L. S. Peregoy, J. W. Millspaugh, E. L. Wood and W. J. Nugent were re-elected on the board of directors of the company.

The Interstate Drop Forge Company is a member of a group of affiliated companies which includes the Sivyer Steel Casting Company, the Federal Malleable Company, and the Chain Belt Company, all of Milwaukee.

T. M. MANLEY, who has served in various capacities for the Morse Chain Company for about 20 years has recently been appointed manager of the district including the Mohawk Valley, Northern New York, Vermont, Western Massachusetts and North Eastern Pennsylvania. Mr. Manley's headquarters are at Ithaca, New York, the main office and works of the Morse Chain Company.

INTERNATIONAL OXYGEN COMPANY announces that the Board of Directors at their meeting on January 17 elected the following officers: A. A. Heller, president; Sol Heller, vice-president; Samuel Heller, vice-president; John Heller, secretary and treasurer.

LORIMER DUNLEVY has resigned his position as sales manager for the Climax Engineering Company of Clinton, Iowa, effective March 15, to take on new duties as general sales manager for the O. E. Szekely Company of Holland, Mich., makers of commercial airplane engines and other products now in process of design.

THE LINCOLN ELECTRIC COMPANY announce the appointment of Mr. O. D. Fries as salesman in charge of consumer motor business in the Detroit territory under the direction of Mr. J. M. Robinson, district manager. Mr. Fries was educated in the Glasgow Royal Technical College and the Glasgow University of Glasgow, Scotland, and since his graduation has had a wide experience in practical and theoretical engineering as well as a wide sales experience.

JOHN S. KRAUSS has been elected president of the L. H. Gilmer Company, manufacturers of moulded rubber and fabric belts for industrial uses. Mr. Krauss joined the L. H. Gilmer Company as factory manager. He was later promoted to secretary and treasurer and followed by assuming the duties of vice-president and general manager.

H. F. T. ERBEN, assistant vice-president of the General Electric Company, retired on January 1, 1928, after more than 40 years of service with that company. At the time of his retirement he was also vice-chairman of the General Electric Manufacturing Committee.

B. L. DELACK has been appointed manager of the Schenectady plant of the General Electric Company as of January 1, 1928. E. A. Wagner has been appointed manager of the Pittsfield, Mass., plant of the General Electric Company, effective January 1, 1928. Sales organization changes include the appointment of C. N. Gregory as manager of the New Haven, Conn., office, succeeding Frederic Cutts, and R. B. Ransom has been appointed resident agent in charge of the Hartford office, succeeding Mr. Gregory.

L. BRANDENBURGER at 149-151 West Second South, Salt Lake City, Utah, has been appointed Salt Lake City representative of the Electric Machinery Manufacturing Company, Minneapolis. R. R. Poppleton, Inc., 36 First Street, Portland, Ore., and 2963 First Avenue South, Seattle, Wash., has been selected to represent the company in the Portland and Seattle districts.

R. T. STAFFORD, formerly district manager of the Seattle office of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has been appointed assistant manager of the electrical department in charge of sales and engineering at the Pittsburgh Transformer Works. John Alberts of the Seattle office has been appointed district manager succeeding Mr. Stafford. The Seattle district embraces the states of Washington and Oregon, having a branch office at Portland.

QUESTIONS *Asked and Answered* *By Readers*

[HERE IS A PLACE *where you can get some inside information when you get stuck. The only restriction is that you do a good turn to the other fellow when he asks a question that you can answer from your experience*]

Rewinding a Portable Drill Armature

We have a small electric drill, of which the armature winding has been stripped, and I am anxious to secure information which will enable me to carry out the job of winding this armature. I believe this drill is a Thor, but the name plate, identification marks and serial number are gone. The motor is a universal type for operation on either direct current or 60-cycle alternating current. Armature is 1 11/16 inches diameter, and contains 14 slots; commutator is 1 1/16 inches diameter and has 42 bars. I would like to know the size wire to use, and any other information that would help in the correct winding of this armature.

York, Pa. M. S.

* * * *

Waterproofing Concrete Wall

During the past winter the paint peeled off the interior of one of the outside concrete walls of the building. Can any treatment be given to the exterior or interior surface which will prevent this? If any other reader has overcome a similar problem, I would appreciate his solution.

Chicago, Ill. E. D. F.

* * * *

Protecting Conveyor From Acid Drippings

We have considerable trouble with a slat conveyor which is used in progressive assembly. The acid used in soldering operations drips on the metal parts and after about a year some of the links or pins begin to fail. Finally, interruptions become so frequent that it is necessary to install a new conveyor. Has any other reader had this difficulty? If so, how has he overcome it?

Battle Creek, Mich. B. M. M.

ANSWERS *Received to Questions Asked*

Question

Determination of Resistance in Coils Delta Connected

We are experiencing difficulty with a piece of equipment that has three coils connected in delta. After a study of the operation of the equipment, it seems as if the resistance of the coil in one phase must be different than the others. These three coils are sealed in such a way that only the leads, which are tapped to the interconnecting points of the coils, are available. It would, therefore, be to our advantage, in several ways if we knew how to determine the resistance of each coil from data obtained by measuring the resistance between the three main phase connections.
Los Angeles, Cal. R. W. D.

REGARDING the question by R. W. D., with such an arrangement of connections, it is necessary in measuring the various resistances to take into account the condition that the measurement between two terminals gives a value which is the joint resistance made up of a parallel circuit which consists of a single phase circuit in one branch and the other two phases in series in the other branch.

The accompanying illustration shows a closed winding with the separate phases represented by X, Y and Z; the terminals connected to the junction points of the windings are marked 1, 2 and 3. The resistances as measured between terminals are represented by A, B and C. It, therefore, follows that a measurement of resistance taken between terminals 1 and 2, 2 and 3, 3 and 1 will have respectively y in parallel with x and z in series, z in parallel with x and y in series, and x in parallel with y and z in series, giving resistances respectively of B, C and A. From a purely theoretical standpoint, a true three-phase delta-connected winding should have equal phase resistances and this resistance per phase would be 3/2 of the resistance between 1 and 2, 2 and 3 or 3 and 1. This can readily be proved from the well known formula given in all text and reference books that $1 \div A$ ($1 \div B$ or $1 \div C$) $= 1 \div x + (1 \div y + z)$ from which it follows that x being assumed equal to y or z the equation can be written $1 \div A = (1 \div x) + 1 \div 2x$ which solved gives $x = 3A \div 2$ (or B or C). This solution, however, from a practical point of view may be far from the actual value even though the three separate measurements 1 to 2, 2 to 3 or 3 to 1 be averaged and for a definite solution a more positive calculation must be resorted to. The three separate resistances as measured between terminals may be expressed according to the well known formula for joint resistances as follows:

$$(1)\ 1 \div A = 1 \div x + (1 \div y + z)$$
$$(2)\ 1 \div B = 1 \div y + (1 \div x + z)$$
$$(3)\ 1 \div C = 1 \div z + (1 \div x + y)$$

Solving these equations with the fewest number of terms we get:

$$(4)\ x = 2(AC + AB + BC) - A^2 - B^2 - C^2 \div 2(B + C - A)$$
$$(5)\ y = 2(AC + AB + BC) - A^2 - B^2 - C^2 \div 2(A - B + C)$$
$$(6)\ z = 2(AC + AB + BC) - A^2 - B^2 - C^2 \div 2(A + B - C)$$

While (4), (5) and (6) may appear complicated it will be seen that the numerator is the same in each formula so that only one set of calculations need be made for this value which will be the same for each equation. If it is believed that equations without the values A^2, B^2 and C^2 are simpler to handle (4), (5) and (6) may be written:

$$(7)\ x = 0.5\,[1 \div (B + C - A) + 1 \div (A - B + C) + 1 \div (A + B - C)]\ [(A - B + C)\ (A + B - C)]$$
$$(8)\ y = 0.5\,[1 \div (B + C - A) + 1 \div (A - B + C) + 1 \div (A + B - C)]\ [(B + C - A)\ (A + B - C)]$$
$$(9)\ z = 0.5\,[1 \div (B + C - A) + 1 \div (A - B + C) + 1 \div (A + B - C)]\ [(B + C - A)\ (A - B + C)]$$

It will be noted that in (7), (8) and (9) that the first portion of each equation is the same, and that in the second part we have the three values A, B and C arranged in the order $B + C - A$, $A - B + C$ and $A + B - C$ each occurring twice. While these also may appear complicated, the application will be found relatively simple. If, for instance, measurements give $A = 1.66$, $B = 2.66$ and $C = 3$, then $B + C - A = 4$, $A - B + C = 2$, and $A + B - C = 1.32$; from these we get $1 \div (B + C - A) = 0.25$, $1/A - B + C = 0.5$, $1/A + B - C = 0.75$. In (7), (8) and (9) the left hand portion or first part of the formula gives:

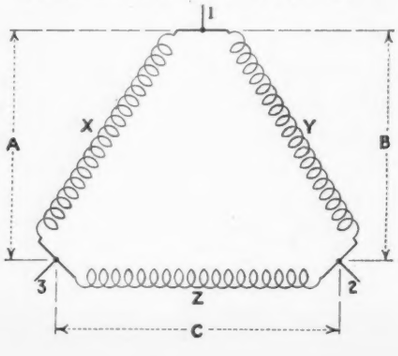
then $0.5\ (0.25 + 0.5 + 0.75 = 1.5 \div 2 = 0.75$

$$x = 0.75 \times 2 \times 1.32 = 1.98$$
$$y = 0.75 \times 4 \times 1.32 = 3.96$$
$$z = 0.75 \times 4 \times 2 = 6.0$$

C. Otto von Dannenberg.
Electrical Division,
General Engineering & Management Corporation,
New York, N. Y.

* * * *

A CLOSED WINDING. The separate phases are represented by X, Y and Z.



Question

Cause of Low Voltage On Exciter

Our company recently installed a 250-kw., three-phase, 60-cycle, 440-volt, 328-amp., belt-driven generator. It is separately excited by a 23-kw., 125-volt, 183-amp. compound-wound generator, which is driven by a belt from the a.c. generator shaft. The exciter heats badly, and will not build up a voltage over 100. In order to maintain the 440-volt line voltage, it is necessary to operate with one rheostat wide open and one completely closed. Will readers please tell me what is causing my trouble, so that I can take the necessary steps to remedy it?
St. Mullins, S. C. J. J.

REPLYING to the question by J. J., the fact that the exciter heats badly indicates either an overload or internal trouble in the exciter.

Although offhand it seems that the 23-kw. exciter is large enough for the 250-kw. alternator, it might possibly be that the trouble is simply one of overload and that the alternator field takes more than 183 amp., which is the limit of the exciter. Or, there may be a fault in the generator field that is causing an abnormal flow of current. Also, there might be current leakage through partial grounds in the connections. As a means of checking the possible causes of trouble, measure the output of the exciter with an ammeter. If the meter reading is not much greater than the rated 183 amp., the trouble is evidently elsewhere.

The speed of the exciter should be checked, and if found O. K., look for a short circuit between the commutator bars or a short-circuited coil. A shorted coil can usually be located by feeling over the surface of the armature, or by watching for spots out of which the varnish is oozing.

The series field may be improperly connected; that is, backwards, so as to oppose the shunt field. This trouble can be tested by noticing how fast the terminal voltage drops when the load is increased. For example, with a certain rheostat setting, and the generator field switch open, the exciter voltage will be, say, 110-volts. If, upon loading the exciter by closing the generator-field switch, the voltage drops to 90 or 80, this is a pretty sure indication that the terminals of the series field need to be interchanged so as to make it "boost" instead of "buck."

The brushes may be in the wrong commutating position. This is hardly possible, however, with a commutating pole machine, for the brush rigging is usually doweled in place.

V. E. Johnson.
Milwaukee, Wis.

ANSWERS *Received to Questions Asked*

Question

Cause of Excessive Arcing at Motor Brushes

The brushes of the hoist motor, on our 15-ton crane, arc excessively. This is a 20-hp., 220-volt, 1,030-r.p.m., 80-amp., series-wound, d.c. motor with four interpoles and I am wondering if the trouble is due to the fact that it is operated from a 245-volt line. Although we have tried various kinds of brushes and have tested both the armature and field coils, excessive sparking persists after the resistance is cut out of the armature circuit by the controller, when either raising or lowering loads.
St. Louis, Mo. H. E. A.

THE trouble mentioned in the question by H. E. A. may be caused by the commutator being out of round or high bars, or even an open circuit. First of all, when checking up the trouble it may be well to see if there is a bad bearing on the commutator end of the motor or, possibly, a poor type of coupling on the drive end of the motor. This condition is apt to exist on old motors that have about ¼ in. between the pole faces and the armature.

In a parallel-connected armature-winding, only one burned spot occurs on the commutator when a coil is open-circuited in the armature. This may be temporarily repaired by wedging the corners of the two burned bars together.

In a series-connected winding, when a coil is open-circuited, a burned spot will be produced on the commutator for each pair of poles. To remove the burned spots join two adjacent bars where the spots appear. The open-circuit in the armature is liable to close when the machine is in operation, and if this were to happen, the coil would be short-circuited and burned out.

Carbondale, Pa. WM. MCGUIRE.

IN REPLY to the question asked by H. E. A., I do not believe that the rise in voltage is directly responsible for the cause of the trouble, as I have seen several motors like the one in question operated satisfactorily at a line voltage above the motor's rating. As the armature and field coils have been tested for open coils, short-circuited coils, cross-connections, and the like, I would advise making the following tests:

See that the brushes make a good even contact; they should be in line with the commutator bars; and, they should be set at a neutral point and diametrically opposite.

Make certain that the commutator is clean and that there are no high or low bars; that is, smooth and not worn out of round. Also, the mica should not protrude up above the surface of the bars.

Test the current demand of the motor while it is running under load to see that it does not exceed the name-plate rating. R. H. FINCH.

Chief Electrician,
Blair Limestone Co.,
Martinsburg, W. Va.

THE arcing trouble experienced by H. E. A. is probably due to a weak field. The field may be weak due to a resistance in the shunt circuit, or perhaps the brushes are not on the neutral position. Running at 25 volts over the rated voltage should not, in itself, cause the trouble mentioned. I certainly would look for the trouble in the field.

If the magnetic coils have not been liberally designed, they may reach the saturation point before the motor is fully loaded. Also, it might be well to determine whether or not the motor is mementarily overloaded when the controller is cut out. W. E. WARNER.

Brentford, England.

IN THE case cited by H. E. A., if the commutator has always arced, it is quite possible that a wrong connection has been made in the armature, or one or more interpoles may have the wrong polarity.

Test the interpoles to see that the north poles are ahead of the north main poles and the south interpoles are ahead of the south main poles.

After making a bar to bar test on the commutator, make certain there is no ground in the armature coils.

Boston, Mass. EDWARD A. GIBBS.

I AM inclined to believe that H. E. A.'s trouble is caused from the interpoles as they would effect the sparking in case the interpoles were too strong. The object of interpoles, of course, is to produce a magnetic field which causes the current in the coil under commutation to reverse and build up in the opposite direction. If the field is too weak, the reversal will occur too late and there will be sparking; if it is too strong, the reversal will come too early, and the current will then build up too high a value and will have to be suddenly reduced as the commutator bars pass out from under the brush, in which case there will be sparks.

Also, the sparking may be caused by the brushes not being in a neutral position on the commutator. When setting brushes in their neutral position on interpole machines, great care must be exercised to set the brushes in their neutral position. H. J. ACHEE.

Superintendent,
Water & Light Department,
City of Woodward, Okla.

Question

Preparing Insulated Pipe for Painting

We are planning on painting our pipe lines but find that the covering on the insulated lines absorbs so much paint that several coats are required to cover it. I wish that other readers would tell me what they have used as a first coat of size to make such surfaces non-absorptive.
Rock Island, Ill. R. M.

IN REPLY to the question by R. M., there are several mixtures that will give satisfactory results when used as sizing on insulated pipe covering; so that less paint will be needed when painting the covering.

One mixture that will give good results can be made up by mixing flour and glue in the form of a thin paste. When applying allow it to soak into the covering and to dry thoroughly before applying the paint.

Another mixture that will give equally good results and, which is probably a little cheaper than the flour and the glue mixture, is composed of resin and gasoline. As this mixture is highly inflammable, great care must be exercised when applying it. For best results the mixture should have a consistency of thin varnish. H. E. STAFFORD.

Electrical Engineer,
Provincial Paper Mills, Ltd.
Port Arthur, Ont., Canada.

CONSIDERABLE paint can be saved on the job mentioned by R. M., by applying a strong glue sizing to the covering on the piping before applying the paint. The sizing is made up by soaking flakes of glue in cold water for about 24 hr., using just enough water to cover the glue. When the glue is soft, it can be melted by applying heat. More water should be added in order to dilute the sizing. Ordinarily, 1 lb. of glue will make 2 gal. of strong sizing which will be capable of thoroughly closing up the pores in the surface of the pipe covering.

No paint should be applied until the sizing is thoroughly dry. It will be found that this sizing will save a considerable amount of paint, if a large surface is to be covered.

Shellac is often used in the same manner as the glue sizing just described, the idea, of course, being to close up the pores in the surface of the pipe covering.

CHAS. A. PETERSON.

Chief Electrician,
Fairbanks Exploration Co.
Fairbanks, Alaska.

AROUND THE WORKS

THIS SECTION *is especially devoted to short articles describing ideas and practical methods devised to meet particular operating conditions. The items may refer to mechanical details of installation, inspection, testing, wiring, repair, maintenance, replacement, and emergency or unusual installations of equipment tributary to production. Special attention is given to shop or bench tools and short cuts or improved methods of handling work brought into the repair shop. Contributions from our readers are always welcome.*

* * * *

Suggestions on Care of Rubber Belting

BELT life is dependent to a very large extent upon the care given to the drive. The necessary attention for rubber belts is, in general, quite similar to that required for leather belts although there are some points of difference which the belt user should thoroughly understand. Belt dressing, for example, is not necessary on rubber belts and the oils contained in a large percentage of the dressings on the market will injure the belt. Leather belts, however, require a certain amount of dressing containing oils to preserve the leather.

The use of resin and some forms of dressing, which appear to give the belt a better grip, will quickly pick up dirt, which cakes and forms a smooth, polished surface on the belt or pulleys. This causes slippage and defeats the intended purpose. All belts and pulleys should be kept clean.

Operating belts over pulleys or shafts out of alignment shortens the life of any type of belt. Babbitt lineshaft-bearings wear, buildings "settle," bolts ease up, and other agents help to throw shafting and pulleys out of alignment. Many belts are abused by being held on the pulleys by guide boards and forced to run out of line. This wears away the protecting edge of the rubber belt and opens up the plies at the side. It is seldom practicable to trim off the worn edge of a rubber or fabric base belt. Periodical aligning of shafting and pulleys will reduce belting costs.

When a rubber belt is cut or torn by accident, it is generally possible to repair the injured part or cut it out and put in a short section of good belt. Cuts or tears, which are not taken care of will soon extend, or cause ply separation throughout the whole belt, thus making it a total loss.

Life of Motor Coils Increased by Dipping and Baking

ONE of the most important problems confronting the electric railways, especially the high-speed lines where light weight is essential, is the gradual deterioration of the insulation of motors and transformers. The dust, dirt and metallic particles on the roadbed, combined with moisture, tend to break down motor insulation putting the car out of service.

We have proven to our own satisfaction, that to increase the life of our motors and transformers it is essential to coat the armature and coils properly with an insulating varnish and thoroughly bake out this coating. A complete dipping and baking equipment has been installed, consisting of a varnish dip tank and an electrically-heated and automatically-controlled Westinghouse armature baking oven.

This equipment has been in continuous operation since installation and the results obtained have been very satisfactory. Indications are that there will be just as great an improvement in the length of life of our armatures and coils as has been secured by other lines using the same equipment.

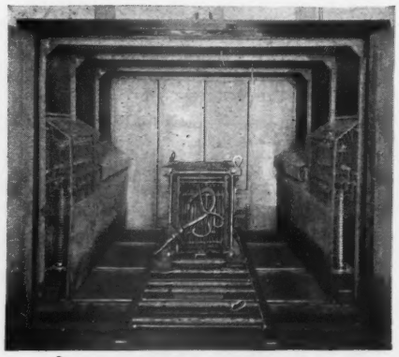
The dipping tank is large enough to take care of our maximum size of transformer or armature. The varnish used is the best that can be secured for this work. The oven measures 6 ft. x 6 ft. x 6 ft. inside (approximate dimensions) and is of sheet-steel sectional construction insulated with mineral wool on all sides, including the doors. Westinghouse Type C oven heaters are mounted on the side walls at the floor line and the temperature is automatically maintained by a thermostat, operating a Westinghouse control panel through relays. This is an enclosed panel and includes relays, contactors, and fuses, for 220-volt, three-phase service. In addition there is a recording thermometer for permanent record of temperatures and a push button station and door switch for the oven heating control equipment.

In order to guard against a possible failure of the control apparatus, a special thermostat and relay are placed in the oven to shut off the current if the maximum temperature should be exceeded. The correct temperature for the size of armature or transformer being baked is maintained automatically so that an absolutely uniform distribution of heat is secured at all times. A small motor exhauster set insures the proper amount of ventilation.

We have been well satisfied with the operation of this equipment and feel that the process is proving beneficial to our service. JAMES T. HAMILTON.
Master Mechanic,
New York, Westchester & Boston
Railway Co., Boston, Mass.

* * * *

INTERIOR of armature baking oven showing roller conveyor used to load and unload the oven.



Compensating for Installation Error in Alignment by Using Couplings

ALTHOUGH the principal function of a flexible coupling is to absorb the effects of accidental misalignments in the connection of two shafts, it can be used to compensate for errors in installations. This practice is not recommended because the error may cause greater misalignment than the coupling is designed to compensate for and still give good life and service. However, in case of emergency it may be necessary to sacrifice coupling life to prevent an interruption of service.

Such was the case in connection with the rearrangement of a paper mill drive. One paper manufacturer had spent several thousand dollars and considerable time in installing a new paper machine. When connecting up the new drive for this and the other machines the entire plant was shut down about ten days.

Plans were made to finish the job one night and start the entire plant the next morning. Later at night, when ready to connect the engine to a jack-shaft from which the necessary auxiliaries were driven, it was found that the engine and auxiliary shaft were so badly out of line that the belts would not stay on their pulleys. It would have required several days to have made the necessary changes.

Although, as stated, the principal function of flexible couplings is to handle accidental misalignments, this was a

case where it was of the utmost importance to get the machines running and to keep them running even temporarily; therefore a flexible coupling was installed between two sections of the jackshaft. One section of the shaft was lined up with the engine and the other section with the auxiliary.

This type of service is extremely hard on the coupling and an extra set of couplings, and perhaps a duplicate coupling, should be ordered at once to be on hand for emergency repairs. In such a case the coupling serves as a universal joint. If another flexible coupling had been available, two couplings could have been used to somewhat better advantage in that each would have taken half of the misalignment. The continuance of such a condition is not recommended but in this case the cost from the continued idleness of the plant would have purchased several bearings.

Chicago, Ill. E. D. F.

Atomic Hydrogen Welding Made Practicable

ATOMIC hydrogen welding can be performed in some cases on metals as thin as the paper on which this is printed. The process by means of which hitherto unweldable metals can be melted and fused without the slightest trace of oxidation is now made practicable by the use of equipment placed on the market by the General Electric Co. This process, making possible the welding of many special alloys and the production of ductile welds in iron and steel, is the result of research conducted by Dr. Irving Langmuir of the General Electric research laboratory.

In brief, this method utilizes the passage of a stream of hydrogen through the arc between two electrodes. The heat of the arc breaks up the hydrogen molecules into atoms. These combine again a short distance beyond the arc into molecules of the gas, and in so doing liberate an enormous amount of heat, so that more effective welding temperatures can be obtained.

Since atomic hydrogen is a powerful reducing agent, it reduces any oxides which might otherwise form on the surface of the metal. Alloys containing chromium, aluminum, silicon or manganese can thus be welded without fluxes and without surface oxidation.

The welding outfit consists of the following: (1) a single-phase transformer for converting the voltage of a 60-cycle source of power to one suitable for the welding equipment; (2) a specially designed variable reactor to provide the proper welding current and voltage for different classes of work, and (3) the welding torch by means of which the actual work of welding is performed.

Although the principle of operation is the same as that involved in the design announced a year ago, the mechanical and electrical design has been much improved. The torch consists of a holder supporting two tungsten-wire electrodes, the electric conductors connecting these

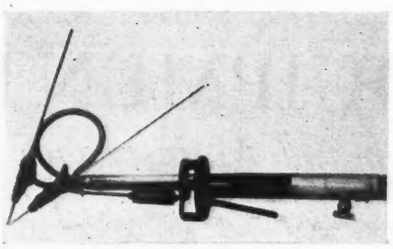


FIG. 1—THE ATOMIC hydrogen welding torch.

* * * *

electrodes to the reactor and the tubing for the hydrogen gas. Each electrode is supported inside a nozzle through which the hydrogen gas is forced out around the electrode. The combination of electrodes and nozzles is set at an angle and the distance between electrodes, or arc length, and also the flow of gas are readily adjustable.

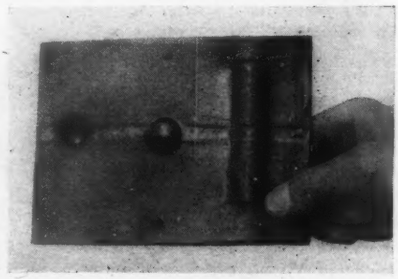
The electric conductors to and through the torch are heavily insulated and, when welding ceases, the welding circuit is automatically interrupted until such time as the operator is ready to weld again, when the circuit is automatically restored. In contrast to the usual method of electric arc welding, there is no current flowing from the electrodes to the work to be welded. The circuit is completed from one electrode to the other.

The reactor consists of a U-shaped core provided with pole faces between which a pivoted armature is arranged to move. The legs of the core are provided with coils connected in series with the electrodes of the welding torch. The amount of welding current and voltage is governed by the movable armature which changes the air gap of the magnetic circuit and therefore the reactance. This armature is normally biased to an open position, and, upon a flow of current through the coils of the reactor, is attracted to a closed position that may be determined by means of a handle and a suitable mechanism. When the arc is struck, the armature automatically assumes the closed position and remains there until welding ceases, when it automatically resumes the normal position of maximum air gap.

In making edge welds, the metal to be welded is melted under the heat of the arc, but when it is necessary to add additional metal, a filler rod must be

* * * *

FIG. 2—A SAMPLE of welded steel plate. This low-carbon steel plate was hand welded and punched in three places to show the ductility of the weld.



used and fed into the arc in much the same manner as is followed in the ordinary gas-welding process.

The new equipment is so far being marketed for operation from 60-cycle, single-phase circuits only, and is recommended for use on ordinary metals of less than $\frac{1}{4}$ in. in thickness, or on hitherto unweldable metals of greater thickness. Metals having a thickness of but 10 mils can easily be welded.

Because of the absence of oxides and nitrides from the weld made by this process, it is particularly adaptable to the welding of special alloys so far not weldable by other methods, and also makes a strong, smooth and ductile weld on ordinary iron and steel work. Inasmuch as pure chromium, nickel, copper, aluminum, silver and other metals and their alloys (not to mention iron and the more common metals) can be melted without oxidation, it is expected that new possibilities will be opened in such welding, although the application has been but partly studied.

Making Pulled Coils

(Continued from Page 184)

by the dotted line, it was necessary to pull the lead through, which puts kinks in the wire.

There is another feature that affects the shape of the coil: namely, its winding angle (see Fig. 20) and the total over-all length. This feature is the type and shape of kick pin jaw used to hold the diamond point while pulling. The kick pin jaws are all laid out so that the center line of the holding pin bears a fixed relation to the center line of the radius used on the jaw irons or sides.

In Fig. 20 the center line of the radius used on the jaw sides is $\frac{1}{4}$ in. behind the center line of the pin used in the jaw. This jaw requires less copper and is used mostly for round wire coils.

In Fig. 21 the center line of the jaw radius is on the center line of the pin. This results in a longer diamond loop, as can be seen by comparing Fig. 20 with Fig. 21.

The loop in Fig. 21 is used mostly for square and ribbon wire coils, since it eliminates a compound bend at the loop and thus puts less strain on the cotton covering on the wire.

For a given shuttle length the loop in Fig. 21 will reduce the over-all length of the coil and also the winding angle; thus the diamond points can be varied to meet almost any condition. By using the oblique diamond point as shown in Fig. 22 and various combinations of relations between the center line of the pin and jaw, it is possible to duplicate the coil extension and weight of a mold-wound coil.

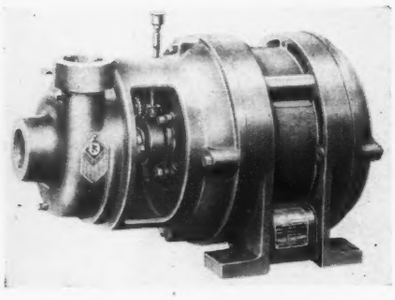
NEW EQUIPMENT

For Plant Operation and Maintenance

Industrial plant executives concerned with the selection and operation of mechanical and electrical equipment will be interested in these new devices which are designed to improve plant operation or reduce operating and maintenance costs.

Centrifugal Pumping Unit

THE type SSU centrifugal pumping unit in which the motor and pump are combined in one unit has been paced on the market by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. The unit is close-coupled by fastening the pump impeller to one end of the motor shaft and bolting the pump casing to a special integrally cast extension of the motor end housings. This construction eliminates a baseplate, coupling and pump bearings and precludes the possibility of misalignment between the pump and motor. It is stated that the motor is fitted with over-



Allis-Chalmers Type SSU Centrifugal Pumping Unit

size tapered-roller bearings, having ample thrust and radial capacity.

The pumps are built in 1¼-, and 1½-, 2- and 2½-in. sizes and can be used with 1-, 1½-, 2-, 3-, 5- and 7½-hp. motors. The capacities handled range from 25 to 200 g.p.m. against heads of from 50 to 100 feet.

Spray Gun for Touching Up

THE Alexander Milburn Company, Baltimore, Md., has recently developed a new touch-up gun known as the Type K-Jr., for general use where a fine spray is required.

The extremely fine mist or spray obtainable with this gun is said to be suitable for decorating, shading, highlighting and blending of colors on any surface, touching up scratches, mars or dents in automobile bodies, machinery, and so on, using lacquer, varnish or paints. It is claimed that a flat horizontal or vertical spray or a round spray can be obtained by a mere touch of the finger. The gun can be operated with an air compressor as small as ¼ hp.

Six feet of air hose, with connections, are furnished with the gun. Either aluminum or glass containers can be furnished so that as many different colors as desired can be kept on hand for ready use. Each container can be had with an air-tight cap so that the material can be kept in condition while in the cup. Aluminum cups are 8 oz. size; glass containers come in 8-, 16-, and 32-oz. sizes.

Fuse Puller

A NEW combined Trico midget fuse puller and screw driver has been placed on the market by the Trico Fuse Manufacturing Company, Milwaukee, Wis.

This little tool, which is made of genuine horn fiber, is 5 in. long and has gripping jaws on one end for handling cartridge fuses ¼ in. to ½ in. in diameter. The other end terminates in a screw driver suitable for use on the small screws found on electric sockets, plugs and the like.

Trolley Hoist

A NEW Hi-Lift hoist, which is especially adaptable in plants with low ceilings, has been developed by the Northern Engineering Works, Detroit, Mich.

This hoist, with I-beam trolley and corner collectors, is provided with two brakes—a motor check brake being attached to the end of the hoist motor armature shaft, and a mechanical load brake in the hoisting gear train. These are positive-type, friction-disk ratchet brakes of the same construction as the mechanical brake that is now used on the other hoists and crane trolleys manufactured by this company.

Another important feature is the one-piece unit casting, its two sides being connected permanently. This construction, it is claimed, keeps the two sides in absolute alignment.

Northern Engineering Works Hi-Lift Hoist

A flexible coupling is used for the hoist motor, and compensates for any slight misalignment.

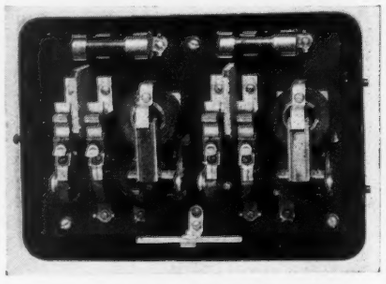
The load hook is capable of being pulled up within 14 in. from the underside of the beam to the center of the hook. Two stops provided: one to prevent the load hook from going up too high, and the other to prevent it from completely unwinding the rope and starting it up on the wrong side of the drum.

The gear covers are split horizontally and can readily be lifted up, permitting inspection of the gearing or removal of any part without disturbing other parts.

Reversing Switches

THREE small switches bearing the designations CR-7009-F-1, F-2, and B-10 and designed for miscellaneous application as across-the-line reversing switches for small motors, have been announced by the General Electric Company, Schenectady, N. Y.

The CR-7009-F-1 and F-2 switches



General Electric Type CR-7009-F-2 Reversing Magnetic Switch

each consist of two 15-amp., double-pole contactors electrically and mechanically interlocked and inclosed in a drawn case. They are for use with momentary-contact pushbutton stations. The F-1 form is without overload relays; the F-2 form has Trumbull overload relays.

The CR-7009-B-10 switch consists of two three-pole, 25-amp. contactors mechanically and electrically interlocked. The switch is for use with a momentary-contact push-button station and has Trumbull overload relays.

Trolley Tap

A NEW design of trolley tap for use around mines has been developed by the Ohio Brass Company, Mansfield, Ohio.

It is claimed that in this new trolley tap the number of parts has been reduced to a minimum and that special attention has been paid to the safety features. These include protective hand guards that greatly reduce the likelihood of accidental contact with the live hook.

Dowel pins on each terminal fit like a tongue in a groove which runs the

length of the holder. Terminals and fuse element are thus kept from turning or twisting inside the case, and there is no chance for the contact lips of the fuse to be twisted off.

This tap is equipped with a renewable, powder-packed fuse. It is stated that the tap is heavy enough, without being bulky or cumbersome, to stand up well under the hard treatment that mine equipment usually receives in servic.e

Hand Fire Extinguisher

DEVELOPMENT of the 1-gal., F-R-X carbon-tetrachloride fire extinguisher, which operates from an air pressure tank, has been announced by the Foamite-Childs Corporation, Utica, N. Y. This unit consists of two seamless cylindrical brass tanks or chambers, one for compressed air and the other for carbon tetrachloride, which are fitted into top and bottom brass castings. A pump is located between the cylinders to replenish the air pressure, or the cylinder may be filled from a compressed-air line.

The flexible chemical outlet tube is constructed of spiral wound bronze reinforced with a braided copper wire covering. It is said that there is no danger of deterioration with this type of tube. The F-R-X extinguisher is equipped with a gage that shows the air pressure at all times and a glass window near the top of the chemical chamber shows whether the extinguisher contains a full gallon of chemical.

The unit may be carried on the back. It is discharged by pulling up the operating lever, which releases the air pressure into the chemical cylinder and also opens the outlet. It is stated that the extinguisher will discharge a continuous stream 35 ft., without pumping.

The extinguisher is especially adapted for use around electrical equipment or lines, on oil fires, and in unheated buildings.

Foamite-Childs F-R-X Gallon Pressure Type Carbon-Tetrachloride Fire Extinguisher

Split-Phase Motor

SEVERAL improvements in design are embodied in the new split-phase motor, designated 58RB, that has recently been put on the market by the Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo.

These advances in design are said to include an improved method of oiling, a heavy, formed steel base that can not be broken, drip-proof endplates, and a spacious terminal that is easy to get at and well insulated to prevent grounding.

Wagner 58RB Split-Phase Motor

One of the outstanding features of this motor is a new centrifugal switch for which unusual length of life and satisfactory service are claimed. This switch, which consists of only a few simple parts, is said to be so constructed that it breaks contact almost instantly and without dragging, never lengthens the contact period beyond the proper point for the motor, and gives a wiping contact without rubbing or undue wear.

The 58RB motor is available in $\frac{1}{8}$-, $\frac{1}{6}$-, and $\frac{1}{4}$-hp. ratings.

Thermal Overload Relay

MARKETING of a new across-the-line type thermal overload relay has been announced by the Industrial Controller Company, Milwaukee, Wis. With the Class 8532 starter, the push-button station may be mounted on the operated machine or at any point convenient to the operator.

The I-C time element thermal overload relay is of the melting alloy type, having a mica-insulated heating element of Nichrome wire or ribbon. The alloy is contained in a cup or cylinder that is back of the heating element and into which the stem of the ratchet wheel extends. When an overload occurs, the thermal unit gradually rises in temperature, finally melting the alloy and allowing the stem of the ratchet wheel to turn. When the ratchet wheel turns, it releases the latch, which operates the auxiliary switch in the magnet coil circuit and opens the contactor.

The relays are stamped with the current which they will carry, and it is claimed that they will trip at approximately 10 per cent above this value when the temperature of the air is 104 deg. F.

All thermal relays are of the hand reset type, but they can be reset without opening the cabinet by pressing the rod on the right-hand side of the box. After an overload occurs, a few moments should be allowed for the relays to cool before resetting.

The horsepower rating of Class 8532 starters can be changed by changing the thermal unit. The unit consists of the thermal element, the alloy cup and the ratchet wheel.

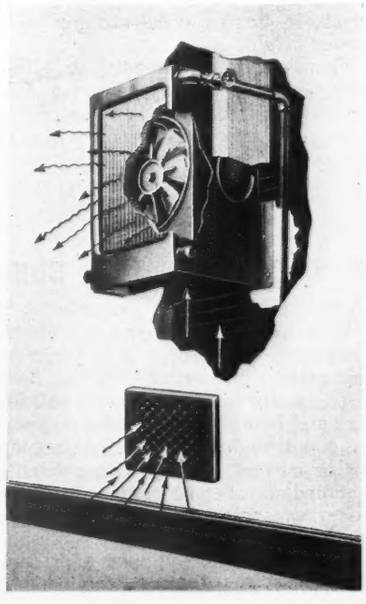
Small Unit Heater

ADDITION of the No. 2 Venturafin to its line of unit heaters has been announced by the American Blower Corporation, 6000 Russell St., Detroit, Mich. This unit is recommended for small areas such as plant offices, small storerooms, garages and small shops, for which the larger units cannot be used on account of their excess heating capacity.

The unit measures 22¾ in. high, 14⅛ in. wide and 12⅞ in. deep and is said to deliver 450 to 900 cu.ft. of heated air per minute, representing a heating capacity equal to 125 to 200 sq.ft. of direct radiation. Like the larger unit, it consists of a special steam radiator through which air is blown. The cold air is drawn from a point near the floor.

The illustration below, shows one of these unit heaters installed in a partition wall. Air is taken through the grill near the floor. Ducts or other methods of installation may be adopted as conditions require.

American Blower Corporation Venturafin No. 2 Unit Heater



Continuous Chart Recorder

THE Brown Instrument Company, Philadelphia, Pa., has long supplied its pressure gages, thermometers and more lately its flow meters in flush-type, circular cases. Announcement is now made that this company is also able to furnish its continuous strip chart instruments in cases of the flush type.

A simple but important feature of the new flush-type continuous chart recorder is an arrangement by which the recording mechanism can be drawn out of the case at the front for easy inspection, after which it can be pushed back into place, a locking device holding it firmly in position.

Handy Air Sprayer

MARKETING of a small motor-driven spraying unit under the trade name of Electric Sprayit has been announced by The Electric Sprayit Company, Inc., Iron St., Detroit, Mich. This unit consists of a hand-sized motor-driven blower, with cord for plugging into a light socket, and a detachable container attached to the blower. The high velocity of the air, it is stated, inspirates the material to be sprayed.

The unit is intended for use with light-bodied paints, varnishes, lacquers, enamels, bronzes, oils or stains and insecticides, exterminators or disinfectants in liquid or powdered form.

Disconnecting Switch

MANUFACTURE of a new disconnecting switch has been announced by Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill. This switch is so designed that the blade is mounted directly on an oil circuit-breaker stud and is adjustable to the proper height by means of a sliding sleeve. The floating contact jaws are mounted on a stud passing through a porcelain tube which, in turn, can be clamped to the proper height.

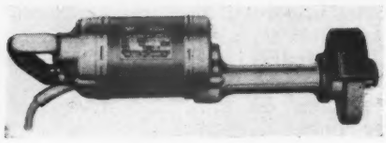
This switch is equipped to lock in either open or closed positions. When the oil circuit breaker is to be removed it is only necessary to open the disconnecting switch and withdraw the breaker, it is said.

Portable Grinder and Buffer

ANNOUNCEMENT is made by The Hisey-Wolf Machine Company, Cincinnati, Ohio, of a new ½-hp. portable grinder and buffer.

The motor is equipped with ball bearings and is of the universal type, operating on either direct or single-phase alternating current. The grinding spindle is mounted on roller bearings. A new-type Hisey two-pole switch controls the motor from the grip handle.

The grinder is equipped with a cast-steel wheel guard which is adjustable so



Hisey-Wolf Portable Grinder

that it can easily be placed at any angle most convenient for the operator. The end cover is removable for replacing grinding wheels.

Immersion Heater

AN electric immersion heater for electroplating solutions and other liquids which will not attack lead has been developed by the General Electric Company, Schenectady, N. Y. It is primarily intended for low-temperature heating only.

The unit consists of a steel-sheathed helicoil unit covered with a lead jacket swaged tightly to the steel unit. The terminals are brought into a terminal box suitable for conduit connections. These heaters are made in two sizes, both for a maximum demand of 5 kw., one for 110-volt circuits and the other for 220-volts. They can be supplied in different formations.

Only the lower portion of the heaters dissipates heat; so they too can be used in tanks in which the level of the solution is as low as 10 in. from the top.

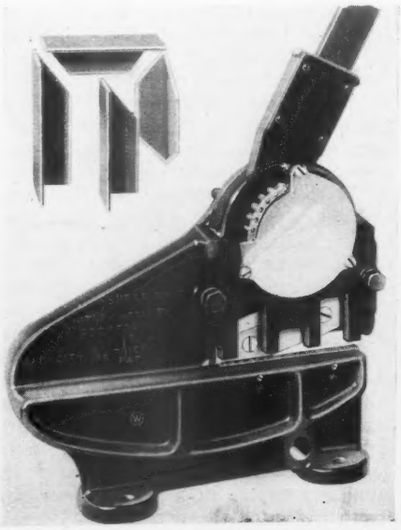
Among the advantages claimed for this unit are ease of installation, portability and low maintenance expense.

Roller Bearing Slitting Shear

THE addition of the No. 6, roller-bearing Slitting Shear for metal up to ⅛ in. thick to its line of punches and shears has been announced by the Whitney Metal Tool Company, Rockford, Ill. This unit and examples of some of the work is shown in the accompanying illustrations.

This shears is made of drop-forged, alloy steel with all wearing parts hardened. Roller bearings are used on the eccentric crank pin and trunnion bearings. The shear is throatless. Provision is made for lubrication. The inserted shear blades are 4½ in. long and the lower blade is adjustable for taking up wear.

Whitney No. 6 Roller Bearing Slitting Shear



Cutting Blowpipe

A NEW cutting blowpipe, known as type C-14, which it is said will not backfire even under the most severe operating conditions, has been added to the line of the Oxweld Acetylene Company, 30 East 42nd Street, New York, N. Y.

This blowpipe uses the same nozzles as the Oxweld Type C-2, which it resembles, although several improvements in design have been made. The three gas tubes are straight, having no bends either outside or inside the handle. The cutting valve is of the same design that is now used on all hand cutting blowpipes made by this company.

The small needle valve bodies and both the head and the rear body of the Type C-14 blowpipe are pressure forgings, instead of castings, giving better appearance, increased durability, and lessened weight.

Interchangeable nozzles are provided so that the blowpipe may be used with either medium- or low-pressure acetylene.

Fast-Blowing Fuse Links

A COMPLETE line of fast-blowing fuse links, which are said to have a minimum fusing current of 115 per cent, has been developed by the W. N. Matthews Corporation, St. Louis, Mo.

It is claimed that this fuse will carry its rated current indefinitely without heating the fuse cartridge beyond 210 deg. F., but when subjected to a current 11 per cent above normal, it will melt in a period ranging from 2 to 12 min., depending on the fuse sizes. The smaller fuses will melt in the shorter period.

Sectional Stock-Box Racks

EASE OF assembly, together with the convenience of adding additional drawer capacity from time to time, are two of the features claimed for the Sturdy-Sectional stock racks made by the Skinner Chuck Company, New Britain, Conn. The cast-iron braces are assembled by means of stove bolts and a special locking device.

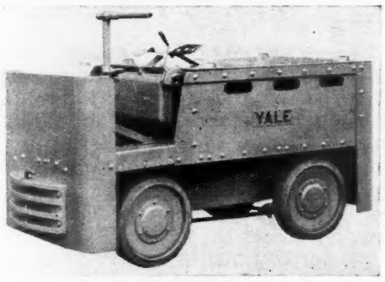
Welded steel drawers 8x12x20 in. in size are regularly provided; compartments can be added, if desired. These drawers can be supplied with drop or stationary handles and can be furnished liquid tight, if required. The drawers travel on rollers set in the frame, so that even when the box is heavily loaded, little effort is required to handle them, it is stated.

Electric Tractor

THE model K24C four-wheel-drive tractor has been brought out by the Yale & Towne Manufacturing Company, Stamford, Conn., to meet the demand for an electric tractor of heavier type. The machine is said to be capable of exerting an ultimate drawbar pull in excess of 4,000 lb., and maintaining a continuous drawbar pull of 1,000 lb. without danger of overheating. By driving through all four wheels, it is possible to get the maximum of traction.

This tractor is equipped with four-wheel brakes which operate through the differentials and, it is claimed, will equalize properly regardless of the condition of the lining. To apply the brakes the foot pedal is allowed to rise, which automatically applies them and opens the cut-out switch in the controller.

The lever steering handle on the model K24C tractor is so arranged that



Yale & Towne Model K24C Tractor

it may be folded up out of the way. The steering knuckles on all four driving wheels are equipped with a ball flush bearing, which makes for ease of steering.

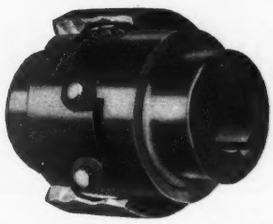
The driving units consist of two standardized units connected in parallel at the controller. This tractor is regularly furnished with a 48-volt motor, and a 23-to-1 gear ratio.

The pressed steel side members of the frame are integral with the axle yokes. This gives the frame a depth of 18 in. The bumpers are made of ½-in. plates and a triple bumper casting front and rear gives a range of coupling heights that will meet practically every requirement.

Flexible Coupling

MARKETING of the new L-R flexible coupling has been announced by the Lovejoy Tool Works, 319-31 West Ohio St., Chicago, Ill.

According to the manufacturer this coupling is based on a new principle that gives it a considerably greater range of flexibility than is ordinarily found in such devices. It is substantially a jaw coupling with radially-disposed, loosely-floating resilient rollers, placed between jaws which extend from the flanges parallel with the



Lovejoy L-R Flexible Coupling

shafts. This assures a rolling contact upon relative movement caused by either misalignment or end movement of the shaft. Either solid rubber or rubber-covered metal rollers are used as conditions require; an external sleeve prevents idle rolls from flying out under centrifugal force. The coupling may be used for rotation in either direction, half the rollers being under compression and the other half idlers.

By virtue of its construction, it is claimed that this coupling can operate successfully under 7½ deg. angular misalignment, parallel misalignment up to $\frac{3}{16}$ in., and an endwise shaft movement of ¾ in.

Air Compressor for Cupola Blowing

A NEW cupola blowing equipment has been designed by the General Electric Company which, it is claimed, will automatically insure the supply of a constant weight of air to the cupola, irrespective of atmospheric conditions and the resistance through the cupola. It is claimed that this greatly increases the efficiency of the melting operation.

A single-stage centrifugal compressor supplies the air. Constant-speed motors are used, except when d.c. motors are required. The weight of air flowing into the cupola is controlled by opening or closing the blast gate, which can be done either automatically or by hand. A meter indicates the volume of air flowing for standard conditions and by making slight adjustments as needed the meter reading can be kept constant.

The equipment has totally-enclosed bearings provided with forced lubrication, minimizing the possibility of wear

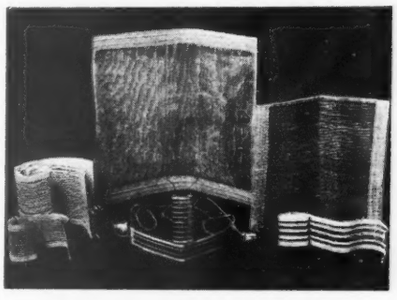
General Electric Centrifugal Cupola Blower

from the dust prevalent in a foundry. A gear-type oil pump, with a gravity feed from an oil reservoir located in the base of the main bearing housing, provides forced lubrication to all bearings. This pump is totally enclosed and immersed at all times in a bath of oil.

All single-stage units will be equipped with 230-volt, d.c. motors, or two- or three-phase, 60-cycle, 220-, 440- or 550-volt motors. Units above 58 hp. rating may be provided with 2,200-volt, a.c. motors. Steam turbines can also be used for the various sizes.

Woven Heater Grid

THE Warren Electric Appliance Company, Inc., Warren, Pa., has developed the Weaco Flexible Woven Heater Grid. This grid is woven on a loom and is composed of either iron or nichrome resistance wire and chemically treated asbestos. The strands of asbestos are woven at right angles to the



Flexible Woven Heater Grids Made by Warren Electric Appliance Company

resistance wire. The grid is shown above.

These grids can be supplied in any size or shape, oblong or square, and for any wattage or voltage for single- or three-heat application. They are intended for low temperature applications or appliances such as room or cab heaters, drying or baking ovens, air or water heaters, and so on.

Baby Socket Wrench Set

THE No. 999 Husky Baby set has been added to the line of socket wrench sets manufactured by the Husky Wrench Company, Milwaukee, Wis. This set is designed for little bolts and nuts as are found on small machines or instruments and on electrical work. Socket sizes are: $\frac{3}{32}$, $\frac{1}{10}$, $\frac{1}{8}$, $\frac{5}{32}$, $\frac{3}{16}$, $\frac{7}{32}$ and $\frac{1}{4}$ in. hex. and $\frac{3}{8}$ and $\frac{7}{16}$ in. square. The square sockets may be used to hold square shank taps. All sockets are hardened and tapered and are stamped with the size of wrench opening.

The combination tee has a self-locking head and a 5-in. handle. The speed screwdriver, which can be used for extension, is 4½ in. long and has a swivel grip for speed. All parts are nickel-plated and burnished. The set is packed in a sheet steel box.

TRADE LITERATURE

You Should Know About

Copies of literature which is described on this page can be obtained by writing to the manufacturer whose name and address are mentioned. It is always advisable to state the name and number of bulletin or catalog desired, as given in these columns.

BLOWERS—Catalog 32 devotes 34 pages to a description of the Bayley Aerovane blowers for delivering a constant volume of air, against a high static resistance, as in forced draft.—Bayley Blower Company, 732 Greenbush St., Milwaukee, Wis.

AUTOMATIC STEAM CONTROL—Bulletin 950 describes the construction and operation of the Tag Automatic Steam-Op (steam-operated) controller, for controlling temperature and pressure by using a portion of the steam supply.—C. J. Tagliabue Manufacturing Company, 18-88 Thirty,third St., Brooklyn, N. Y.

ADJUSTABLE FIXTURES — Catalog 6 devotes 32 pages to illustrating, describing and listing the various types of American adjustable electric light fixtures and to showing numerous applications. — American Fixture Company, 230-232 West Water St., Milwaukee, Wis.

RESISTORS—Bulletin 111 describes and illustrates applications of Monitor Edgewound resistors for highest current values, Hexwound for intermediate current values, and Smoothwound for the lowest current values.—Monitor Controller Company, Gay, Lombard & Frederick Sts., Baltimore, Md.

ELECTRIC FURNACES—Bulletin 4 describes the operation of the Ajax-Northrup oscillator or spark-gap type of high-frequency converters and furnaces, operating from static converters. —Ajax Electrothermic Corporation, Trenton, N. J.

STEEL RACKS—A circular illustrates some of the types of arc-welded steel racks constructed by this company.—Lewis-Shepard Company, 134 Walnut St., Watertown Station, Boston, Mass.

PORTABLE SAW—A gasoline-driven, portable saw rig with tilting table is illustrated and described in a recent bulletin.—Chain-Belt Company, Milwaukee, Wis.

PORTABLE PUMP—Construction and operation of the Durex gasoline-engine driven, portable, diaphragm pump are covered in a recent bulletin.—Chain Belt Company, Milwaukee, Wis.

MAGNETIC SEPARATORS — The construction and design of separator pulleys as well as several sets of tables giving the cubic feet per hour capacity of separator pulleys of various sizes and the correct width and thickness of belts to be used, are contained in an interesting booklet.—The Cutler-Hammer Manufacturing Company, 1205 St. Paul Ave., Milwaukee, Wis.

ARC WELDERS—A general description of the Fuzon flexible arc welder and the advantages claimed from its use, are given in a recent bulletin.—Fusion Welding Corporation, One Hundred and Third St. & Torrence Ave., Chicago, Ill.

AIR SEPARATORS—A circular covers the use of the Gast compressed air separator, describes its action and gives various installations. — Smith-Monroe Company, 1910-1912 South Main St., South Bend. Ind.

SPEED CHANGER — A new folder describes the JFS variable speed transmission. — Stephens-Adamson Manufacturing Company, Aurora, Ill.

UNIT HEATERS—A 16-page bulletin entitled, "Putting Idle Heat to Work," illustrates a number of applications and discusses the use of York heat-diffusing unit heaters in industrial plants.—York Heating & Ventilating Corporation, 1502 Locust St., Philadelphia, Pa.

FLANGING MACHINE.—A circular describes the Sievert adjustable flanging machines of hand and power types. The hand type unit will take metal up to 12 gage.—Morey, Jones & Lovell, Inc., 922 South Hemlock St., Los Angeles, Calif.

METAL SHEAR—A circular describes the Midget Unishear which can be used either as a hand tool or a stationary bench tool for cutting sheet metal up to 18 U.S. gage.—The Unishear Company, Inc., New York, N. Y.

VARIABLE SPEED TRANSMISSION — A recent circular gives the speed and power schedule and other facts regarding the JFS speed transmission. —Stephens - Adamson Manufacturing Company, Aurora, Ill.

GRATING—Bulletin C-527 describes the construction and application of Tri-Lok for grating and treads.—The Tri-Lok Company, 5527 Butler St., Pittsburgh, Pa.

UNIT HEATERS—The Architects' and Engineers' Edition of the catalog on Univent Ventilation discusses the use of the Univent for heating and ventilating.—The Herman Nelson Corporation, Moline, Ill.

GRATING—A circular illustrates the application of Blaw-Knox Electroforged steel grating and flooring for industrial purposes.—Blaw-Knox Company, Farmers Bank Building, Philadelphia, Pa.

ROLLER CHAIN — Booklet 104 entitled, "Simplifying and Improving Machine Design," is profusely illustrated with applications of both single- and multiple-strand roller chains on internal drives for machines used in a wide variety of industries.—Diamond Chain & Manufacturing Company, Indianapolis, Ind.

INDUSTRIAL HAULAGE EQUIPMENT—The line of Clark gasoline-propelled tractors and lift trucks of standard and special models and tote boxes for trucks are illustrated and described in the 48-page catalog 5. Illustrations of applications are taken from a wide variety of industries.—The Clark Tructractor Company, Battle Creek, Mich.

ROLLER BEARINGS — Catalog 4-A illustrates, lists and gives specifications of the line of Rollway cylindrical roller bearings in the wide series and utility types. A series of bulletins gives data for the use of Rollway roller bearings for pillow blocks and other applications. — Rollway Bearing Company, Inc., Syracuse, N. Y.

STARTING EQUIPMENT—A series of new bulletins and price sheets for incorporating in the Allen-Bradley catalog, to bring it up to date to February 1928, has been issued.—Allen-Bradley Company, 491 Clinton St., Milwaukee, Wis.

FLEXIBLE COUPLINGS—A circular describes the L-R flexible coupling which, it is stated, will permit angular misplacement up to $7\frac{1}{2}$ deg. and lateral misalignment to $\frac{3}{16}$ in. with an end play up to $\frac{3}{4}$ in.—Lovejoy Tool Works, 325 West Ohio St., Chicago, Ill.

BELT FASTENERS—A group of booklets give price lists and information of sizes of Talcott clinching belt fasteners for rubber and fabric transmission and conveyor belts up to 1 in. thick.—W. O. & M. W. Talcott, Inc., 91 Sabin St., Providence, R. I.

CRANES—Bulletin No. 179 devotes 32 pages to the operation and maintenance of Whiting electric cranes.—Whiting Corporation, Harvey, Ill.

HEATING UNITS—The March, 1928, issue of the Chromalox bulletin illustrates and describes several interesting applications of these heater units.—Edwin L. Wiegand Company, Pittsburgh, Pa.

FILTERS—A new folder describes the National air filters, for all types and all sizes of air compressors.—National Air Filter Company, 5130 Ravenswood Ave., Chicago, Ill.